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Swiss Accident Investigation Board SAIB

Aviation Division

Final Report no. 2161 by the Swiss Accident Investigation Board SAIB

concerning the accident involving the EA500 aircraft, registration N177EA

on 14 March 2011

Saanen aerodrome (LSGK) / BE

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Ursachen

Der Unfall ist darauf zurückzuführen, dass eine Landung durchgeführt wurde, obwohl sich zu diesem Zeitpunkt noch ein Fahrzeug auf der Piste befand. Dies führte dazu, dass das Flugzeug beim Ausrollen mit diesem Fahrzeug kollidierte.

Die folgenden Faktoren haben zum Unfall beigetragen:

- Die zu hohe Anfluggeschwindigkeit im Endanflug führte zu einer vergrösserten Landedistanz.
- Der Pilot wies auf dem Unfallmuster und im Betrieb auf kurzen Pisten nur ein geringes aktuales Training auf.

Als systemische Ursache wurde ein Pistenbelegungskonzept ermittelt, welches in verschiedener Hinsicht Sicherheitsmängel aufwies.

General information on this report

This report contains the Swiss Accident Investigation Board's (SAIB) conclusions on the circumstances and causes of the accident which is the subject of the investigation.

In accordance with Art 3.1 of the 10th edition, applicable from 18 November 2010, of Annex 13 to the Convention on International Civil Aviation of 7 December 1944 and Article 24 of the Federal Air Navigation Act, the sole purpose of the investigation of an aircraft accident or serious incident is to prevent accidents or serious incidents. The legal assessment of accident/incident causes and circumstances is expressly no concern of the accident investigation. It is therefore not the purpose of this investigation to determine blame or clarify questions of liability.

If this report is used for purposes other than accident prevention, due consideration shall be given to this circumstance.

The definitive version of this report is the original in the German language.

All times in this report, unless otherwise indicated, are stated in local time (LT). At the time of the accident, Central European Time (CET) applied as local time in Switzerland. The relation between LT, CET and coordinated universal time (UTC) is:
LT = CET = UTC + 1 hour.

Final Report

Aircraft type	Eclipse Aircraft Corporation EA500	Registration: N177EA
Operator	Liebherr-Geschäftsreiseflugzeug GbR, Pfänderstrasse 50-52, 88161 Lindenberg, Germany	
Owner	Shoal Bay Inc., 4100 Chestnut Avenue, Newport News, VA 23607, USA	

Pilot	German citizen, born 1949
Licences	Airline transport pilot licence (airplane) (ATPL (A)) according to the Federal Aviation Administration (FAA), issued on 28 January 2011. Airline transport pilot licence (aeroplane) (ATPL (A)) according to joint aviation requirements (JAR), first issued by the German Federal Aviation Office (LBA) on 2 November 1990, valid till 13 June 2014.
Essential ratings	Instrument rating (IR) Airplane multi-engine land CE-525, EA-500S
Medical fitness certificate	Class 1 with the restriction holder shall wear corrective lenses according to the Federal Aviation Administration (FAA), issued on 25 October 2010

Flying hours	**total**	10,640 hours	**during the last 90 days**	approx. 40 hours
	on the accident type	approx. 40 hours	**during the last 90 days**	approx. 40 hours

Location	Saanen aerodrome (LSGK) / BE		
Coordinates	---	**Elevation**	1008 m AMSL
Date and time	14 March 2011, 13:05 LT		

Type of operation	IFR/VFR private
Flight phase	Landing
Type of accident	Collision with a vehicle

Injuries to persons

Injuries	Crew	Passengers	Total number of occupants	Others
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	0	0	0	0
None	1	4	5	2
Total	1	4	5	2

Damage to aircraft	Cracks in the airframe, damage to the left engine
Other damage	Spray arm of the vehicle damaged

1 Factual information

1.1 Pre-history and history of the flight

1.1.1 General

The flight of the Eclipse Aircraft Corporation EA500, registration N177EA, was a private flight from Innsbruck (LOWI) to Saanen (LSGK), which was conducted for the majority of the flight according to instrument flight rules; the approach and landing took place under visual flight rules (ATC flight plan Y).

On board, in addition to the pilot in command (PIC) were four passengers: a couple with a daughter - the husband, who flew as a private pilot mainly on single-engine light aircraft, had taken the front right seat beside the PIC. Behind, on the passenger seats, sat another pilot, who was converting to the same aircraft type and who for this purpose accompanied the pilot in command on as many flights as possible.

The description of the history of the flight and of the subsequent events is based essentially on the statements of the PIC and of the two pilots on the passenger seats; also, two persons who were in Saanen on the runway at the time of the approach were interviewed as part of the investigation. The owners of the airport, Flugplatzgenossenschaft Gstaad-Saanenland (FGGS) [the Gstaad-Saanen-land aerodrome cooperative] and the operating company of Saanen aerodrome were also consulted.

Further helpful information was provided by photos, taken with the mobile phone camera of the passenger in the front right seat beside the PIC, plus data from the installed diagnostic storage unit (DSU), which carried on recording until the aircraft reached a height of 59 ft above aerodrome level (AAL).

1.1.2 Pre-history

The PIC, accompanied by the pilot in conversion training, made a ferry flight from Friedrichshafen (EDNY) to Innsbruck, from where they were to convey the above-mentioned couple with their daughter to Saanen. Subsequently a ferry flight had again been planned back to Friedrichshafen.

In order to obtain the permission for Saanen (prior permission required - PPR), the PIC had submitted in writing a request to the operating company of Saanen aerodrome. This permission was granted to him after he had cconfirmed in writing that landing, taxiing, parking and taking off has to be conducted under his own responsibility.

1.1.3 History of the flight

On 14 March 2011 aircraft N177EA took off from Innsbruck at 11:15 UTC. After an uneventful flight, when at an approximate altitude of 10 000 ft AMSL and positioned west of Bern, the pilot changed from instrument flight rules (IFR) to visual flight rules (VFR) after consultation with air traffic control. The remainder of the flight was routed from Zweisimmen over the villages of Saanenmöser and Schönried on the southern side of the valley. The pilot chose a direct approach from the east on runway 26 at Saanen aerodrome. Already before the commencement of the flight, the pilot had enquired by telephone in Innsbruck whether he could fly such a direct approach; this was confirmed to him.

When approximately 10 NM from runway 26, the pilot reported for the first time shortly before 13:00 LT on the Saanen aerodrome frequency. When he did so, he was informed of a prevailing wind of 5 kt in the direction of the runway 26 centre line. Shortly afterwards, when he turned onto the runway 26 approach line for his

final approach, he saw that there was a vehicle on the runway. The pilot reported again on the frequency with the words: *"Da ist noch einer auf der Bahn"* [There's still one on the runway]. Immediately afterwards, he was told that the vehicle would be out of the way immediately.

The vehicle concerned was an 'airport de-icer' (cf. chapter 1.5), which with extended arms at approximately 12:50 LT was laying a spray pattern on the runway on the central marking, approximately 180 m from the end of runway 26. This preparation was taking place on the occasion of an annual presentation of airport equipment on Saanen aerodrome which took place over three consecutive days and which included practical demonstrations.

The pilot in the passenger cabin also followed the verbal exchange on the aerodrome frequency, without being able to determine exactly whether the vehicle was still on or had already cleared the runway. At about this time the approach speed was 105 KIAS[1], according to his observation, at a height of approximately 500 ft AAL.

The pilot then continued the approach on the assumption that the vehicle would turn off immediately and vacate the runway. From his perspective, however, he could not judge this so accurately. According to his own statements, he began to reduce the speed to the planned approach speed of 90 KIAS for the final approach. Analysis of the data from the DSU showed that before initiating the flare at a height of 59 ft AAL, the last recorded approach speed was 108 KEAS[2].

When he flew over the beginning of the runway, the pilot took back the power to idle and positioned the aircraft approximately on the displaced runway threshold. The pilot was aware of the available landing distance of 1080 m published in the Swiss aeronautical information publication (AIP) and this seemed to him to be sufficient, according to his prior calculations.

Accordingly, immediately after touchdown the pilot assessed the situation as not yet critical and began to brake the aircraft in the usual way. However, when he determined that the vehicle in question was still on the runway he was concerned, according to own statements, and as a result increased the pressure on the brake pedals. According to the pilot, the tyres burst at about the time when N177EA was rolling past the aerodrome building; the wheels were no longer providing any braking effect and the aircraft was now difficult to control.

The two persons busy operating the airport de-icer became aware of N177EA for the first time as a result of the noise of the approaching aircraft. At that time they were analyzing the spray pattern on the left side of the vehicle facing west, at the level of the rear axle.

Over the remaining 80 meters or so, the pilot attempted to steer the aircraft to the right of the vehicle but was unable to avoid a collision with the airport de-icer. The aircraft's left wing passed under the right spray arm of the vehicle. The front section of the left side of the fuselage and the left engine collided with the spray arm at an estimated rolling speed of approximately 30 to 40 kt. The aircraft came to a standstill at 13:05 LT a little over 130 m before the western end of the runway, at the northern edge of the runway.

The pilot and the passengers in N177EA were able to exit the aircraft uninjured. The operating crew of the airport de-icer was uninjured.

[1] KIAS: knots indicated airspeed.

[2] KEAS: knots equivalent airspeed.

The Aircraft Accident Investigation Bureau (AAIB) was informed of the accident at 13:40 LT on 14 March 2011 and the investigation was then begun at 14:45 LT.

1.2 Information on the site of the accident

Accident location	Saanen aerodrome, municipality of Saanen/BE
Date and time	14 March 2011, 13:05 LT
Lighting conditions	Daylight
Coordinates	584 825 / 148 283 (Swiss grid 1903) N 46° 29' 08'' / E 007° 14' 27'' (WGS 84)
Elevation	1008 m (3307 ft) AMSL
Landing distance runway 26	1080 m (3543 ft)
Final position	Approx. 173 m west of the displaced runway threshold 08, near to the northern edge of the runway

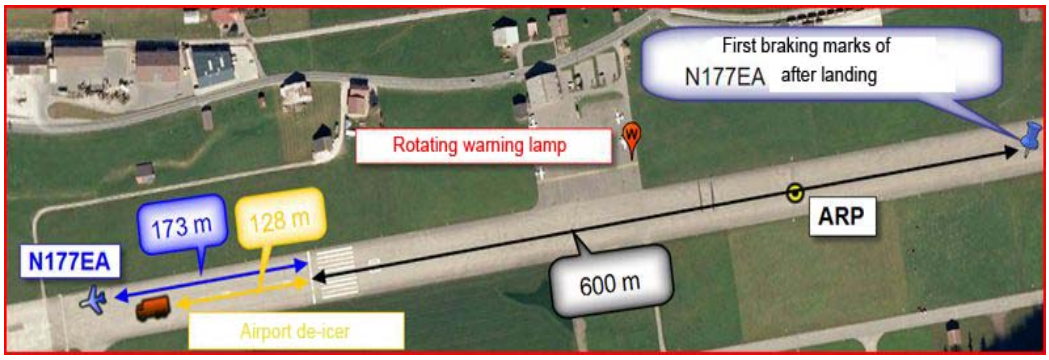

Figure 1: Final position of the Eclipse EA500 (N177EA) on runway 26 in Saanen (LSGK); also cf. Annex 1: AD-INFO of Saanen aerodrome

1.3 Aircraft information

1.3.1 General

Registration	N177EA
Aircraft type	EA500
Characteristics	Very light six-seater jet aircraft.
Special features	An anti-skid system for wheel brakes, aerodynamic aids to reduce lift after touchdown and a thrust reverser were not available.
Licence	The aircraft is licensed by the Federal Aviation Administration (FAA) and by the European Aviation Safety Agency EASA for single pilot operation (single pilot aircraft - SPA) for flights under VFR and IFR, provided that certain functions such as autopilot and from the control yoke operable transponder identification and push-to-talk button for operation with a headset are available. In Europe the aircraft may not be operated commercially in single-pilot operation.

Manufacturer	Eclipse Aviation Corporation, Albuquerque (New Mexico), USA
Year of manufacture	2010
Serial number	177
Engine type	Pratt & Whitney PW610F-A
Max. permitted take-off mass	6000 lb (2722 kg)
Max. permitted landing mass	5600 lb (2540 kg)

1.3.2 Diagnostic storage unit

The diagnostic storage unit (DSU) uses a 2 GB cyclical memory as a circular buffer for recording flight data, corresponding to a total time of 240 hours; once the memory is full, the oldest flight data is overwritten. The data is saved in a one-minute cycle to the memory and completed by a pointer. This ensures that the next time the engines are started, data recording continues seamlessly.

On N177EA an error was recognised in the DSU software during the data download, whereby the last minute of the flight data was not fully saved, when the power supply to N177EA was cut off. As a result of the missing pointer, the last minute was overwritten again. As a result, after analysis of the DSU recordings, data was only available up until the point when the aircraft reached a height of 59 ft AAL. The recording of the last waypoint was at 13:03:18 LT.

The data in the recordings showed that the flaps of the N177EA were set to the landing position. The power setting of the engines showed a low-pressure compressor speed N1 of 32% of the rated speed, and a high-pressure compressor speed N2 of 56% of the rated speed. The engine inlet temperature (EIT) was 31 °C.

The last mass recorded in the DSU, shortly before landing, was 5470 lb (2481 kg).

1.3.3 Mass and centre of gravity

Assuming an average mass per occupant of 73.5 kg and on the basis of the masses for baggage shown in the flight plan of 60 lb (approx. 27 kg), and fuel in the tanks of 1300 lb (approx. 590 kg), the following values for zero fuel mass, take-off mass and landing mass result:

Zero fuel mass:	4648 lb (2108 kg)
Max. permitted zero fuel mass:	4922 lb (2233 kg)
Take-off mass:	5918 lb (2684 kg)
Max. permitted take-off mass:	6000 lb (2722 kg)
Landing mass:	5315 lb (2411 kg)
Max. permitted landing mass:	5600 lb (2540 kg)

With the planned trip fuel of 603 lb (273 kg) the resulting values are consistent to the figures stated in the flight planning. The corresponding centres of gravity were also within the permitted limits.

1.3.4 Information on landing performance

The information in the aircraft flight manual (AFM) concerning landing distances relates to landing distances from an obstacle height of 50 ft (15 m). The manufac-

turer gives no information in the AFM regarding distances from the touchdown point to standstill, the so-called 'landing roll'. In this regard he was not able to provide further performance data when requested.

1.4 Information on the pilot

In January 2011 the pilot completed the conversion to the EA500 aircraft at the Eclipse Aviation Corporation; subsequently, he flew the aircraft over to Europe himself. In total, the pilot had approximately 40 hours of flying experience, with 23 landings, on the aircraft type involved in the accident.

Within the framework of EA500 conversion and retraining, the pilot flew to twelve airports before the flight involved in the accident. The rounded-off runway lengths indicate that the shortest runway had a length of at least 1500 m.

ICAO	Runway length [m]		Reference elevation [m]
	min.	max.	
KABQ	1800	4200	1632
KSUS	1500	2200	130
KPHF	1950	2420	10
CYUL	2130	3350	36
CYYR	2900	3360	49
BGBW	1830		34
BIKF	3050		52
EDNY	2350		417
ETNL	2500		43
LROP	3500		96
LRSB	2100		124
LFLC	3000		333
EGPC	1800		35
LFBD	2800	3000	50
LFGA	2900		150

Table 1: Airports flown to by the pilot on EA500 (N177EA).

No syllabus showing the individual stages of the conversion is available.

In the years from 1991 to 1995, according to his own statements, the pilot had completed an instruction for Saanen at Aeroleasing and in the process had made multiple take-offs and landings on a Falcon 10 aircraft. Also, in 1996 he flew a Cessna Citation C525 to Saanen aerodrome.

1.5 Information on the vehicle

The special purpose vehicle involved in the accident was the product of a company, which among other things manufactured utility vehicles for road and airport snow clearance. The airport de-icer involved in the present case had two laterally extendable spray arms and with the arms extended on both sides had an overall width of 15 m.

Figure 2: Airport de-icer with warning lamps 2L and F1 (photo does not date from the day of the accident).

When the lateral spray arms of the vehicle are extended, the warning lamps 2L and F1 mounted on the arms are activated automatically (cf. Figure 2). Warning lamp 1, mounted on the vehicle's cab, must be put into operation manually. At the time of the accident all the warning lamps were operational, but warning lamp 1 was not in use.

1.6 Organisational and management information

In a contract regulating the organisation and operation of Saanen Gstaad aerodrome dated 22 March 2005 between the FGGS and the operating company, annually recurrent events were listed; in it, however, the above-mentioned annual event to present the airport equipment was not included. Furthermore, the contract contains the following provision: *"Über Vermietung des Flugplatzes für weitere nicht der Aviatik dienende Anlässe oder die Erweiterung der bisherigen Veranstaltungen entscheidet die FGGS und die [Betriebsgesellschaft] einvernehmlich"* [The FGGS and the operating company will jointly agree concerning the renting of the airfield for other events not relating to aviation or the extension of the previous events].

The FGGS stated in response to a request for an operating concept for the mixed use of Saanen aerodrome valid at the time of the accident [translated from German]: … that on FGGS's side, no mixed use would occur and the above-mentioned snow clearance vehicle would be used by or on behalf of the operating company.

The following was agreed between the manufacturer of the airport de-icer, which organised a demonstration of snow clearance vehicles on Saanen aerodrome from 15 to 17 March, and the Saanen aerodrome manager [translated from German]: 'Either flight operation applies or the runway is available for the presentation or for preparation thereof'. In this regard, it was specified that a rotating warning lamp (traffic light) would be activated on the apron of Saanen aerodrome as soon as air traffic was expected. The runway would then be cleared accordingly and released for air traffic.

This regulation had already been applied in previous years and was known to at least one member of the operating crew of the airport de-icer. In the run-up to the demonstrations and during preparation, no briefing took place; the operating crew of the airport de-icer was told on the morning of the day of the accident, when they asked, that the same arrangements would apply as in previous years.

Other means of communication, such as radio or mobile telephones, were not used. A person from the operating company at Saanen aerodrome, who was in the C-Office at the time of the accident, confirmed this fact, according to which there was no other way of informing the airport de-icer crew apart from the warning lamp.

The aerodrome manager at Saanen aerodrome was amazed that the operating crew and the airport de-icer were on the runway at the time of the approach without he himself or anyone from the Saanen aerodrome operating company being informed in advance. He stated, that shortly before noon, at approximately 11:45 LT he had left the C-Office and had informed the airport de-icer crew in discussion that there will be air traffic from 13:00 LT on. According to him the airport de-icer crew said that the job would be done in maximum 10 minutes and that they would leave the runway thereafter.

The airport de-icer operating crew stated that the warning lamp on the apron was clearly visible at all times from their location at the end of runway 26, in particular when it was switched on. They had themselves orientated on this warning lamp in each case before they navigated the runway. When N177EA landed on runway 26 in Saanen, however, they said the lamp was not in operation.

Since no relevant recordings or evidence are available, it could not be determined in the course of the investigation whether the warning lamp was actually in operation when N177EA started to land.

1.7 Meteorological information

1.7.1 General

The information in chapter 1.7.2 to 0 was provided by MeteoSwiss and is translated from German.

1.7.2 General meteorological situation

A low was located over northern Spain and with southerly high-altitude winds during the day directed moister air to the southern side of the Alps. North of the Alps, in contrast, the southerly winds acted to break up the clouds.

The wind and temperatures forecast for the northern side of the Alps were as follows:

Altitude	*[degree/kt]*	*Temperature*
Ground	*VRB 03-05 kt, 'bise' wind tendency towards midday*	
5000 ft	*190/020*	*3 °C*
6400 ft	*-*	*0 °C*
10 000 ft	*230/025*	*-6 °C*
18 000 ft	*245/015*	*-22 °C*

The wind and temperatures forecast for the western region of Switzerland were as follows:

8000 ft	*VRB/10 kt*	*-2 °C*
13 000 ft	*190/15 kt*	*-12 °C*

1.7.3 Weather along the flight path under visual flight rules

The flight path lay in the vicinity of the two sections 52 and 53 of the general aviation forecast (GAFOR), which at the time of the accident both forecast a cloud base of more than 2000 ft above ground and visibility values of more than 8 km.

1.7.4 Weather at the site of the accident

For Saanen aerodrome, neither a terminal area forecast (TAF) nor meteorological aviation weather report (METAR) was issued.

From the TAF and METAR reports for surrounding airports and with the aid of radar and satellite images, the following weather conditions at the site of the accident can be summarised:

Cloud:	*1/8 at 10 000 ft AMSL, 5-6/8 at 25 000 ft AMSL*
Weather:	*-*
Visibility:	*Over 30 km*
Wind:	*West-south-west at 5 kt*
Temperature/dewpoint:	*12 °C / -01 °C*
Atmospheric pressure:	*QNH LSZB 1014, QNH LSGG 1014*
Position of the sun:	*Azimuth 188 °, elevation 41 °*
Hazards:	*None detectable*

1.7.5 Camera image

The picture below was recorded at 13:00 LT, thus shortly before the time of the accident, from the Gstaad Palace Hotel looking in a northerly direction. It provides an impression of the prevailing weather conditions when N177EA was on final approach to runway 26 in Saanen. This state of affairs is indicated here by the red arrow in Figure 3, from right to left.

Figure 3: Image from the camera at the Gstaad Palace Hotel in the direction of the final approach on runway 26 in Saanen.

1.7.6 Recording of wind data

The wind data recorded by the DSU indicates a low and variable wind speed of 3 kt during the final approach on runway 26 at Saanen aerodrome.

2 Analysis

2.1 Technical aspects

There is no evidence of the existence of any technical defects or limitations which could have caused or influenced the accident.

The values for the engines during the final approach, N1 32%, and N2 56% respectively, as recorded by the DSU, correspond to idle power. Thus it was immaterial that this aircraft was not equipped with an autothrottle system. The measured engine inlet temperature (EIT) of 31° C during the approach means that the ice protection system was switched off.

It is quite understandable that devices for thrust reversal or spoilers are not prescribed or offered for all categories of jet aircraft. On the other hand, the lack of an anti-skid system on an aircraft which typically touches down at a speed of 80 to 118 kt, corresponding to 148 to 218 km/h, represents an increased risk.

As this accident shows, when maximum braking is applied there is a risk of the tyres bursting and adversely affecting the controllability of the aircraft, making it impossible to predict the braking distance.

2.2 Human and operational aspects

2.2.1 Experience and training status of the pilot

The pilot had considerable total flying experience at the time of the accident. His flying experience on the EA500 was acquired after conversion on the manufacturer's premises and within a short period of less than two months. Therefore his training status at the time of the accident may be described as good, though he had little experience on the type involved in the accident.

The fact that in relation to the conversion to the aircraft type there is no evidence of any form of training programme which was completed raises the question whether the pilot was sufficiently acquainted with the new aircraft type.

As Table 1 shows, all approaches and landings were made at airports with runway lengths of 1500 m or more. This suggests that the landing performance of the aircraft was never a limiting factor, and in this regard the pilot did not consider that he was faced with any particular flying challenges.

Approaches on a mountain airfield with a short runway are very demanding, especially in a fast aircraft, and cannot be compared with the airports flown to during conversion (cf. Table 1).

The pilot stated that he had last made take-offs and landings on similar aircraft types in Saanen in 1996. This fact permits the conclusion that he had no actual training with regard to an approach at Saanen aerodrome.

2.2.2 Calculation of landing distance

The following values were used for the calculation of the required landing distance:

- Aerodrome elevation: 1008 m (3307 ft) AMSL
- Runway slope: -
- Mass of the aircraft: 5400 lb (approx. 2450 kg)
- Approach speed: 92 KIAS
- Wind speed: No wind
- Outside air temperature: 12° C
- Ice protection system: Off

When the flaps are fully extended and the ice protection system is switched off, the information in the aircraft flight manual (AFM) prescribes an approach speed of approximately 92 KIAS, corresponding to a touchdown speed of approximately 77 KIAS. On a dry runway with a hard surface, with an obstacle height of 50 ft (15 m) a landing distance of more than 1050 m is produced. This value was interpolated from the AFM tables for uncorrected landing distances for an obstacle height of 50 ft and takes into account neither wind conditions nor any runway slope.

The last speed recorded by the DSU was 108 KIAS at a height of 59 ft AAL. On the basis that during the last part of the approach the engines were at idle, it can be assumed that the approach speed of N177EA before initiation of the flare was significantly higher than 105 KIAS and was therefore at least 10 kt above the approach speed recommended by the AFM. Assuming a flare according to the AFM, by analogy with the above considerations the pilot would therefore have landed N177EA at a touchdown speed of approximately 90 KIAS.

In the absence of information from the manufacturer, the landing performance at a higher approach speed can be estimated as follows: the ratio of the effective approach speed to the approach speed prescribed by the AFM is approximately 105 kt / 92 kt = 1.14. As a result the quadratic dependence of kinetic energy on speed it can therefore be concluded that the ratio of the landing distances is a factor of approximately 1.30; consequently, the extra distance on the landing distance according to the AFM due to the excessive approach speed, using a cautious estimate, is at least 300 m, so the required landing distance is approximately 1350 m.

2.2.3 Approach

Saanen aerodrome is an uncontrolled airfield. For a pilot, this means that he is essentially responsible for all flight and taxiing manoeuvres. After the pilot had confirmed that to the Saanen aerodrome operating company this fact was obviously known to him.

When the pilot realised, on turning onto the runway 26 approach line, that a vehicle was on the runway, he continued the approach after he had been informed on the aerodrome frequency that the vehicle would immediately vacate the runway. According to his own statements, the pilot continued the approach on the assumption that the vehicle would turn off immediately and vacate the runway. As he himself stated, however, he was unable to observe this situation precisely with his own eyes. Nor is there any evidence that he asked for confirmation to this effect on the aerodrome frequency.

He continued his approach solely on the basis of the report that the vehicle would soon vacate the runway. A go-around would have been possible at any time until touchdown. Finally, the pilot landed the aircraft on the runway even though the airport de-icer was still on it. With this decision, he took a large, incalculable risk, because he could only hope from this moment on that he could bring the aircraft to a standstill before reaching the vehicle.

The available landing distance of 1080 m on runway 26 at Saanen, specified in the AIP, corresponded approximately to the required runway length according to the AFM. This would have required a stable and precise final approach in terms of approach angle and airspeed. The excessively high approach speed indicates that the pilot did not carry out such a precise approach.

The pilot was apparently not aware, despite his prior calculation of the landing distance, that he had very little in reserve for a successful landing on runway 26,

and this may have caused him to carry out the landing despite a speed on the final approach that was clearly too high.

2.2.4 Aspects concerning regulation of runway occupancy

With regard to regulation of runway occupancy two different statements were made: on the one hand that of the airport de-icer operating crew, according to which the runway was available to them when the rotating warning light (traffic light) was not in operation and on the other hand that of the aerodrome manager in the C-Office, according to which they had not been informed of a repeated occupancy of the runway for demonstration purposes using the airport de-icer. The statement according to which the aerodrome manager had already oriented the operating crew at approximately 11:45 LT about upcoming air traffic does not exclude short-term flight schedule changes in the end; N177EA left Innsbruck not until 12:15 LT whereby its take-off was not confirmed. Summing up it can be said that the expectations of the parties involved were therefore fundamentally different. This must be attributed to a deficient concept of utilisation and insufficient consultation between those involved.

For the runway occupancy agreement a warning lamp was used which, at least from the end of the runway, was not clearly distinguishable and merely constituted one-way communication. This type of device therefore did not represent an adequate warning device.

3 Conclusions

3.1 Findings

3.1.1 Aircraft

- The EA500 aircraft was licensed for IFR and VFR operation.
- The aircraft exhibited no technical defects or limitations which may have affected or caused the accident.
- The mass and centre of gravity of the aircraft were within the permitted limits.
- The aircraft was not equipped with an anti-skid system.
- Under the conditions of the accident flight, the landing distance in Saanen calculated using the aircraft flight manual (AFM) is approximately 1350 m.

3.1.2 Pilot

- The pilot was in possession of the necessary licences for the flight.
- There are no indications of the pilot suffering any health problems during the flight involved in the accident.
- The pilot had a total experience of 10 640 hours, including approximately 40 hours on the type involved in the accident.
- The last landing with a similar aircraft on Saanen aerodrome took place in 1996.
- It was known to the pilot that he basically had to bear responsibility over all flight and taxiing manoeuvres.

3.1.3 History of the flight

- This was a flight under an ATC flight plan Y from Innsbruck with an approach and landing under visual flight rules in Saanen.
- The pilot chose a direct approach from the east at Saanen aerodrome on runway 26, over the villages of Zweisimmen and Saanenmöser.
- On turning onto the base line of runway 26 for the final approach, the pilot noticed an airport de-icing vehicle at the end of runway 26.
- On the Saanen aerodrome frequency, the pilot was informed on request that the airport de-icing vehicle would vacate the runway immediately.
- The pilot continued the approach and landed the aircraft just after the displaced threshold of runway 26.
- During the landing roll, the pilot braked heavily and the tyres on both main landing gear wheels burst.
- The pilot attempted to steer the aircraft past the airport de-icing vehicle which was still on the runway.
- A sideways collision occurred in which the left side of the fuselage and the left engine collided with the right arm of the airport de-icing vehicle.
- The aircraft came to a standstill at 13:05 LT some 130 m from the end of runway 26.

- The pilot and all occupants of the aircraft were uninjured.
- The two people on the runway next to the airport de-icing vehicle were also uninjured.

3.1.4 General conditions

- The arrangement agreed between the operating crew of the airport de-icer and the Saanen aerodrome operating company had significant safety deficiencies in various respects.
- The available landing distance specified in the AIP for runway 26 at Saanen is 1080 m.
- The weather had no influence on origin of the accident.

3.2 Causes

The accident is attributable to the fact that a landing was carried out even though at that time a vehicle was still on the runway. This meant that the aircraft, in the course of its landing roll, collided with this vehicle.

The following factors contributed to the accident:

- The excessively high approach speed on final approach led to an increased landing distance.
- The pilot had had little actual training on the aircraft type involved in the accident and in operation on short runways.

The identified systemic cause was a runway occupancy concept which had safety deficiencies in various respects.

4 Safety recommendations and measures taken since the serious incident

4.1 Safety deficiency

None.

4.2 Measures taken since the accident

The SAIB has been notified by the Federal Office of Civil Aviation (FOCA) about the following measures:

Subsequent to the accident, the FOCA had a meeting with the airport regarding the safety of operational aspects. The following measures were agreed upon:

- *Introduction of an airport briefing as well as PPR request (the pilot has to sign a form that flight procedures and elevation of the airport are known)*
- *Blockade of the airport access road*
- *Introduction of a concept preventing pedestrians from entering the runway*
- *Instruction of personnel regarding information to pilots and securing the runway*
- *Instruction of runway concept for non-aeronautical activities*
- *Creation of a basic concept document for notification of incidences to the FOCA*
- *Termination of agreement concluded with landowners (farmers) regarding the use of grass strips adjacent to the runway*

Implementation and introduction of those measures have been checked by the FOCA.

Payerne, 14 November 2012 Swiss Accident Investigation Board

This final report was approved by the management of the Swiss Accident Investigation Board SAIB (Art. 3 para. 4g of the Ordinance on the Organisation of the Swiss Accident Investigation Board of 23 March 2011).

Berne, 10 January 2013

Annex 1: AD-INFO Saanen aerodrome