Ref. No CZ-07-392

Copy No: 2

FINAL REPORT

**Investigation on the accident
to PITTS S-2B
at Olomouc airfield
on 8 September 2007**

Prague
November 2007

The present document is the translation of the Czech Investigation Report. Although efforts are made to translate it as accurate as possible, discrepancies may occur. In this case the Czech version is authentic.

A) Introduction

Operator: private owner

Aircraft type:	AVIAT AIRCRAFT INC., PITTS S-2B
Registration:	G-SIIB
Location of Incident:	Olomouc airfield (LKOL)
Date and Time:	8 September 2007, at 13:11 (All times are UTC)

B) Synopsis

On 8 September 2007 Air Accidents Investigation Institute of the Czech Republic (AAII) was notified by director of a public air show at the Olomouc airfield (LKOL) of the air accident of an airplane PITTS S-2B, which took place in LKOL southern part. The pilot took off from LKOL and was going to land at Moravská Třebová airfield (LKMK) as scheduled. On taking off he climbed to a position east of the airfield and directed the plane in a flat spin. During recovery of the flat spin, when pulling out, the plane hit the ground at LKOL´s south-east part. The pilot on board was alone and was not injured. The airplane undercarriage, power unit, wing and fuselage were damaged at the impact.

AAII inspectors came to the accident site on the same day and launched an investigation into the accident causes, assisted by the police of the Czech Republic.

The cause of the incident was investigated by an AAII commission comprising:

Investigator in charge:	Ing. Stanislav Suchý
Members:	Ing. Lubomír Střihavka

The Final report was released by:

AIR ACCIDENTS INVESTIGATION INSTITUTE
Beranových 130
199 01 PRAHA 99

On the 17 December 2007.

C) The Final report includes the following main parts:

1) Factual information
2) Analysis
3) Conclusions
4) Safety recommendation
5) Appendices

1 Factual information

1.1 History of the flight

1.1.1 Events before critical flight

In connection with his flight on 8 September 2007 the pilot stated he had planned in the morning to fly to the Jihlava airfield. However, on taking off from LKMK the weather was not good for flight, so after about eight minutes he landed back at LKMK airfield. After learning over the phone about the air show taking place at Olomouc, he decided to fly to Olomouc in the afternoon. On taking off he flew direct to LKOL airfield.

In his supplementary statement the pilot said that already when he came over LKOL airfield he performed a flat spin. He began the aerobatic manoeuvre approximately at ALT 3,400 ft without using smoke and finished with pull-out at 200 m AGL in position "Downwind" RWY 28. After pulling out he went on to approach on landing. A landing time of 10:08 is recorded in AFIS LKOL take-off and landing records. After landing he taxied to the hard standing to park the plane. He planned to fly back from LKOL to LKMK at 13:40. The pilot also said he had been present at a briefing organized for air show participants as scheduled.

A flight exhibition of PITTS S-2B airplane was not included into the agreed air show programme of the day.

1.1.2 Critical flight

The critical flight reconstruction was based upon statements of the pilot and witnesses at LKOL airfield, the record of PITTS S-2B aerobatic manoeuvre made by a video camera and AFIS LKOL controller´s operation records.

A starter at airfield manoeuvring area informed the AFIS controller that the PITTS S-2B airplane would be flying at a time reserved for a rescue helicopter demonstration. The pilot announced take-off on the AFIS controller frequency. According to communications record he did not inform the AFIS controller about his decision to show an aerobatic manoeuvre. In the AFIS LKOL take-off and landing reports, the OK-GIB take-off time is entered at 13:06 UTC. On taking off he climbed in a circle into airspace over the eastern part of the airfield.

The pilot said in his statement that he had entered his plane to the aerobatic manoeuvre, a flat accelerated spin, ca in ALT 3,400 ft with the smoke system switched on. During the manoeuvre smoke got into the cabin. The pilot explained the smoke had obstructed his view from the cabin. This along with rapid rotation deteriorated his orientation making him react three turns later when pulling out. He pulled out the flat accelerated spin by handling the plane in a standard way starting to rotate in a sharp spiral. He stopped the spiral rotation to be lengthwise with RWY 28. He tried to pull out the dive to fly horizontally but he lost the speed and the airplane sank and hit the ground. The undercarriage absorbed the shock, got destroyed, and the airplane went on sliding on the belly.

The pilot was not injured. When the airplane came to a halt he got off the cabin not needing any help from people coming up to the place of accident.

A witness with aviation qualification, who was standing at the airfield manoeuvring area, said he had not talked to the PITTS S-2B pilot since his arrival to the aerodrome and had not known about his intention to show an aerobatic manoeuvre. The witness did not see the flight before the aerobatic manoeuvre, he was on the way from the hangar to the area when he saw the airplane PITTS S-2B flat spinning at an altitude of about 800 to 900 m over the ground. Judging from the sound, the engine worked full power. The

airplane rotated flat and was in smoke. After about three turns the witness saw the airplane movement change. During another few turns the lengthwise inclination was changing but the witness could not say if the airplane was recovering. The spiral manoeuvre continued, the airplane making two further turns, the last seemed to be controlled and was stopped in the RWY 28 direction. According to the witness, the recovery seemed as if the pilot would have pulled out a few metres above the ground.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	0	0	0
Serious	0	0	0
Minor/None	0/1	0	0

1.3 Damage to aircraft

The airplane was damaged as it hit the ground and moved on the belly. The main undercarriage legs were broken as well as the lower half-wing main beam, the propeller was distorted, the engine was stopped by force, the tail wheel got broken off, the fuselage structure was dented in. The airplane condition is in Fig. 1.

Figure 1 The accident site – airplane G-SIIB

1.4 Other damage

No other damage sustained.

Figure 2 The accident site – marks from airplane‘s impact south-east part of LKOL airfield

1.5 Personnel information

1.5.1 Pilot

Personnel data:

- male, aged 33 years,
- holder of PPL(A), issued by CAA of the Czech Republic on 18 Jul 2005, valid to 2012,
- ratings: SEP land, conferred by CAA on 22 Jun 2005,
  ACR, conferred by CAA on 12 April 2007,
- last medical certificate Class 2, renewed on 2003, valid to 2008.

Flying experience:

Total pilot time on all types according pilot logbook to last record:

- total all types: 68 hours 58 minutes,
- as PIC: 27 hours 30 minutes,
- on PITTS S-2B: 37 hours 58 minutes,
- as PIC on PITTS: 14 hours 30 minutes,
- total last 90 days: 9 hours.

The pilot began PPL (A) training on the C-150 in 2003. He finished the training and passed a licence proficiency check on 22 Jun 2005. He was trained in a standard way.

The pilot said he had made several flights on Cessna planes after getting SEP qualification, but no such flights are put down in the pilot logbook. According to LAA (Light Aircraft Association of the Czech Republic) pilots register, the pilot took an microlight pilot training course in 1996. He was issued with a new ultralight pilot license on 10 April 2003 after having passed a revalidation. On the revalidation form of 01 Jun 2005 the pilot stated his total flying hours on ultralights amounted to 220 hours. Regarding his flying activities, the pilot also said he had accumulated around 400 hours flying his own airplane Fascination D4BK as he worked as an LAA display pilot and with WD Technik Company in air shows home (Czech Republic) and abroad. His pilot license for ultralights has been outdated since 18 February 2007.

On 11 September 2006 the pilot with the instructor had flown PITTS S-2B airplane, reg. G-SIIB, from its previous owner in Great Britain to the Czech Republic. Then the pilot performed the difference training on PITTS S-2B, which finished on 23 September 2006. From 30 September 2006 he continued training on the same aircraft to get aerobatic qualification (higher level) following an airplane training program (AK-MOT). The pilot finished his training by passing check on 12 April 2007.

In the period that followed the pilot flew PITTS S-2B, mainly at Moravská Třebová airfield. He practised aerobatic exercises with autorotation and smoke effects. Based on evaluation of his aerobatic skill, the pilot-instructor allowed him on 29 August 2007 to make aerobatic flights up to an altitude of 300 m over the airfield.

On the accident day prior to the crucial flight, the pilot made two flights lasting around 20 minutes.

The pilot-instructor assessed the pilot´s aerobatic skill before the public as very good. The pilot had already produced an application for aerobatic show permission for officiall approval by Civil Aviation Authority. He for instance had presented his aerobatic show at an ultralights show in the town of Jehnědí on 01 September 2007.

1.6 Aircraft information

1.6.1 Basic airplane information

Type:	PITTS S-2B
Registration:	G-SIIB
Manufacturer:	AVIAT AIRCRAFT INC.
Year of manufacture:	1991
Serial number:	5218
Certificate of airworthiness:	valid to 30 August 2008
Certificate of maintenance review:	valid
Total flight time:	696 hours 04 minutes (at 29 August 2007)
Assurance certificate:	valid to 10 September 2007

The PITTS S-2B airplane reg. G-SIIB is a single engine two-seat biplane with a three-point fixed undercarriage with tail wheel.

Power plant:

Type of engine.	Textron Lycoming AEIO-540-D4A5
Serial number:	L-24620-48A
Year of manufacture:	1991
Propeller:	Hartzell HC-CZYR-4CF/FC8477A-4
Serial number:	DN 3909
Year of manufacture:	1991

1.6.2 History of aircraft operation

The airplane is registered with the Civil Aviation Authority of the United Kingdom. The pilot is registered as a new owner on 11 September 2006. A regular annual check on the airplane was carried out on 20 February 2007. It is not apparent from the record who carried out the check. No substantial defects have occurred on the plane since the annual check.

1.7 Meteorological information

According to the Czech Hydrometeorological Office, the southern end of a warm front was advancing to the east across the northern part of the Czech Republic.

According to the METAR the meteorological conditions on LKMT and accident site was:

Surface wind:	280°-330° / 6-12 kt
Wind:	2000 ft, +12°C 340° / 20 kt, 5000 ft, +06°C 320° / 25 kt
Wisibility:	more than 10 km
Weather:	scattered- overcast type clouds
Clouds:	FEW/SCT Cu, Sc, base 2500-3000 ft, BKN SC 4000-5000 ft
Turbulence:	NIL

The radar images over the town of Olomouc between 13:00 and 14:00 showed there was no significant precipitation cloudiness. Precipitations if any were classified as weak occasional rain.

Meteorological conditions according to METAR Přerov airport (LKPO) at 12:00-14:00 on 8 September 2007:

„0809 1200 METAR LKPO 081200Z 32006KT 9999 FEW029 BKN045 17/12 Q1016 NOSIG“

„0809 1300 METAR LKPO 081300Z 31007KT 280V360 9999 SCT029 BKN045 17/12 Q1015 NOSIG“

„0809 1400 METAR LKPO 081400Z 31011KT 9999 FEW029 BKN047 16/13 Q1015 NOSIG“

The pilot said he started the manoeuvre at 3,400 ft and flew under the lower cloud base.

According to AFIS LKOL traffic documentation, the weather at 13:00 was as follows:

Surface wind:	330° / 6 kt
Wisibility:	more than 10 km
Clouds:	BKN
QNH:	1016 hPa

1.8 Aids to navigation

On board the plane there was standard radio navigation equipment.

1.9 Communications

The pilot had radio contact established with LKOL AFIS dispatcher´s frequency 118.0 MHz.

1.10 Aerodrome information

RWY 28 was in use at LKOL aerfield. The aerodrome layout and TWR buildings restrain view of THR RWY 22 area from the AFIS dispatcher station as well as view of the accident place.

There was traffic on the aerodrome marked manoeuvring area. Apart from aerial public show there was entertaining and publicity program organized in one part of the aerodrome. The organisers allowed visitors to access the parked planes belonging to the air show participants.

1.11 Flight recorders

On board the aircraft there was no equipment whose record could have been used to the flight analysis. To analyse the manoeuvre, a TV video record was used that had been originally made by the aerfield visitors.

In addition, the commission used the radio communications record between the AFIS dispatcher and the airplanes. Due to a poor quality the record has been readable with difficulty.

1.12 Description of incident site

The airplane hit grassy land at the aerfield's south-east boundary at a small angle. The impact coordinates are 49°35´9.67´´ N and 17°12´47.16´´ E.

In hitting the ground, the tail wheel was bent and separated, main undercarriage was destroyed, and the main beam of the lower left wing was broken. Through the shock and subsequent movement the engine was stopped by force and the propeller blade tips were bent backwards.

The fuselage in front of the cockpit got distorted slightly, its aft part remained integral including the tail plane. The rudder skin was torn on its right-hand side as it was hit by the tail wheel.

The inter-wing struts, reinforcing cables, and cables of lateral and longitudinal control remained intact and secured properly. The cockpit and canopy were not damaged. Engine and propeller controls were off. Instrument equipment in front and aft cabin was not damaged. The altimeter pressure was set at 29.15 In.Hg / 986.5 mb and the indicator showed 78 ft. The accelerometer indicated 9.4 g.

On 26 September 2007 the airplane was examined thoroughly. It was confirmed that the plane had been damaged at the accident as it hit the ground. There were rests of grass and soil from the landing place on the fracture surfaces. Checking the airplane controls no faults were discovered that could have affected its functionality. The smoke making tube communicated with the engine exhaust nozzle. There was around 20 litre of fuel oil in the tank. On disassembling the engine, it was found that the bracket of the engine electric starter was broken. The bracket broke due to the starter´s inertial forces at the impact. The fracture surface nature was that of forced break.

There are four air venting holes on the airplane. Two of them are in front of the cockpit head shield; the others are on the left and right-hand sides of the aft cockpit. Air venting hole flaps have no common control mechanism. They are hand operated, each of them independently. The front cockpit flaps cannot be controlled from the aft cabin in flight. After the accident both of the holes in front of the head shield were full open; the left side hole was half-open. The cabin canopy is not airtight; in its aft part there is only bandage to dampen vibration.

1.13 Medical and pathological information

The pilot was fastened with a five point system of safety belts. He steered the plane till the moment it hit the ground. When the plane hit the ground the pilot suffered no injury and was not treated by doctors.

At 16:28 the pilot was positive breathalysed for alcohol. He explained that he had drunk 0.5 l beer after the accident before 15:00.

1.14 Fire

There was no fire at the accident location.

1.15 Survival aspects

The persons who saw the accident from the hangar came up to the wrecked airplane but the pilot did not ask for any help.

1.16 Tests and research

NIL

1.17 Organizational and management information

The organizer of the public air show was the Statutory city of Olomouc. Civil Aviation Authority granted consent to organize the public show (permission) and set conditions under which it can take place. However the permission did not include the part of program that concerned the public display of microlights.

The organizer was obliged to make sure that the program be organized in compliance with legal rules and Conditions for organizing aerial public shows no: CAA –SLP -001-0/05 of 01/07/2006. Within the Air Show Program from 12:00 a series of aerial demonstrations was scheduled at which pilots of civil and military airplanes and paratroopers should perform. According to the flight director´s explanation, a flying club´s appointed official was responsible for the safety of air traffic during the program realization. Apart from watching over the aerial daily program, the flight director also took care of invited guests and their activities at airport grounds.

The public aerial performance of the PITTS S-2B pilot was not part of the Air Show Program approved.

The flight director first reported the accident on the phone saying that it took place as the PITTS S-2B landed. Then the air show performance program went on.

1.18 Additional information

Section II Normal Procedures of PITTS S-2B flight manual states guidelines for flat spin recovery:

> *„For flat spin recovery – use full opposite rudder followed by full forvard stick and full aileron with the rotation. Aileron is applied simultaneously with forvard stick. Apply recovery controls positively.“*

Section IV Signs says among other things:

> *15. On left hand side of rest cockpit fairing:……..*
>
> *„For spin recovery put ailerons neutral, apply full opposite rudder briskly and then apply nose down elevator. Use power off for all spin recoveries.“*

A test pilot of the aircraft manufacturer gave his opinion on the flat spin recovery. According to his experience, the height loss in one flat spin turn is around 500 ft depending on contra-action control coordination, propulsion unit regime, weight and centre of gravity position of the airplane.

With regard to the quality of the manoeuvre video record it is not possible to asses whether or not the pilot handled the spin recovery correctly. The test pilot said that possible mistakes causing long pullout delays might be as follows:

- Engine was at full power during recovery,
- Using opposite aileron angles during recovery,
- Pushing of elevator before applying rudder against spin turn.

The test pilot made no comment on potential differences concerning the flat accelerated spin.

A smoke system had been installed on the airplane for the show. It was on and worked till the moment the plane hit the ground. The pilot instructor said that smoke had never been used during training flights with instructor. Smoke flights are allowed with only one person on board. The pilot had been using the smoke system since May 2007 to practise aerobatic manoeuvres including the flat accelerated spin.

The smoke could have come into the cabin through ventilation holes, the pilot said. He also said the holes are normally shut, and neither he nor the technician opened them before the flight. He thought that they might have been opened by aerodrome spectators as they had been allowed to enter the cabin and take photos when the plane was on stand after arrival at LKOL.

1.19 Useful or effective investigation techniques

The incident has been investigated in accordance with Annex 13.

2 Analysis

When investigating the accident, the commission had no flight data available from which to know how the pilot was handling the plane as there were no recording instruments on board. Therefore the aerobatic manoeuvre and the critical flight phase were analyzed solely on the basis of pilot´s and witnesses´ statements and a video record.

2.1 Crucial situation leading to height loss

As is apparent from the video record, the airplane hit the ground during its aerobatic manoeuvre because its height above ground after stopping the sharp spiral in the RWY 28 direction was insufficient to pull out its nose dive. There were no signs of plane´s controls failures at aircraft inspection. The pilot mentioned no problem to affect the plane´s flight performance.

The airplane lost its height during the intentional aerobatic manoeuvre. The commission analysed circumstances relevant to process of manoeuvre.

2.1.1 Pilot's qualification, training and experience

The pilot had adequate aerobatics qualifications. The pilot-instructor qualified his abilities as appropriate to cope with aerobatic manoeuvres with PITTS S-2B including spin and recovery, so on 29 August 2007 he let him perform aerobatics up to a height of 300 m over the aerodrome surface.

The pilot did not get an approval by Civil Aviation Authority (CAA) to perform aerobatic show. If the performer has no certificate to entitle him to perform, he is not allowed to fly aerobatics at an air show, according to Provision 4.8.2 of Regulation "Conditions for Organizing Public Air Show, CAA-SLP-001-0/05 of 1st July 2006".

The pilot himself saw his mistake in that he was late to begin pulling up because of poor visual orientation judgement due to smoke in the cabin. With regard to the flat spin recovery procedure he said it is different from the standard aerobatic techniques as used in training in the Czech Republic.

The pilot did have experience in using smoking effects during aerobatic manoeuvres, but now it was the first time he had to face the situation with the cabin smoke, which had a remarkable affect on his orientation.

2.2.2 Fail to master aerobatic manoeuvre

In analyzing the flat spin recovery through a video record, eight and a half turns were identified in the spin and subsequent sharp spiral ended in the recovery direction, after beginning autorotation (not shown on video). The aerobatic manoeuvre presents the following phases:

a) at least three flat spin turns in about 10 seconds, with smaller pitch and faster rotation,

b) three spin turns with remarkable change in pitch in about 8 seconds,

c) two and a half turns in sharp spiral till the stop of sharp spiral in direction of recovery,

d) nose-dive pull-up in straight direction, stall, and fall down on the ground at high speed.

Since experience shows that 500 ft height lost corresponds to one flat spin turn, it means that a 3,000 ft height lost in 3 flat accelerated spin turns and then in 3 autorotation turns can be regarded as a rough estimate only.

The pilot began to pull out the flat accelerated spin too late and too low, which prevented him from making a safe dive recovery at 300 m above the ground after stopping autorotation. The height lost for a dive recovery after stopping autorotation is roughly 700 ft for PITTS S-2B plane, according to information available. That is why the pilot began pulling out the dive at a height where the recovery was impossible to control and the plane necessarily hit the ground.

The pressure datum set at the PITTS S-2B altimeter did not correspond to QNH at LKOL airfield – 1,016 hPa.

3 Conclusions

3.1 The commission determined the following conclusions:

3.1.1 Pilot

- was aerobatics rated and had valid medical certificate,
- his aerobatics experience corresponded to total flight hours on PITTS S-2B airplane, his flying skill being assessed as good,
- had no break in flying practice, meeting the minimum flying practice requirement,
- decided to make aerobatic manoeuvres at arrival at and departure from LKOL without approval to perform before the public.

3.1.2 Airplane

- had valid airworthiness certificate and was airworthy,
- there was no instrument aboard the plane to clarify the accident,
- in taking check on airplane parts that remained intact at the accident, no failure of aircraft structure or controls was discovered,
- it follows from the propeller check that engine was running at the impact, likely without defects and at full power.

3.1.3 Flight and accident circumstances

- meteorological conditions were not likely to limit the height of the aerobatic manoeuvre entry and to prevent safe recovery at a height of 300 m above ground,
- the altimeter did not indicate the right value of altitude above see level or height above LKOL grounds,

- in training aerobatic manoeuvres with a smoke making device on, the pilot never experienced situation when smoke got into the cabin to affect his orientation. The pilot did not check the ventilation holes position before take-off,
- it is apparent from the video record that smoke partly veiled the cabin after the plane entered autorotation, which suggests it could have penetrated to the cabin through the holes half opened,
- apart from the smoke, the pilot did not point out any problem to affect the recovery from the flat accelerated spin,
- on entering the flat accelerated spin, the airplane made, including ending of sharp spiral, eight and a half turns during which the height loss was so big as to prevent a safe dive recovery,
- there was an apparent change in the movement character of airplane pitch, perhaps as a consequence of entering the spin recovery,
- although the pilot pulled the control stick to the full, he was not able to prevent the airplane from striking the ground because the airplane was already too low when its rotation in sharp spiral stopped and when it started uncontrolled dive pulled-up lengthwise RWY 28.

3.2 Causes

The accident was caused by combination of more factors:

- pilot's intention to make aerobatic show without having permission,
- pilot's loss of visual orientation due to smoke after the airplane entered flat accelerated spin,
- a long time to recover orientation caused the flat spin recovery to be delayed, which lead to loss of height preventing the manoeuvre from being finished successfully and safely above the ground.

4 Safety recommendations

It follows from the accident investigation that certain measures should be taken with regard to pilot training and organizing aerial public shows aimed at paying more attention to pilot's discipline so that they would not overestimate their abilities before the public.