

# Investigation Report

## Identification

Type of Occurrence:	Accident
Date:	29 June 2013
Location:	Eberswalde-Finow Airfield
Aircraft:	Airplane
Manufacturer / Model:	Moravan n.p. Otrokovice Czechoslovakia / Z 526 AFS-V
Injuries to Persons:	One person fatally injured
Damage:	Aircraft destroyed
Other Damage:	Photovoltaic equipment
Information Source:	Investigation by BFU external experts for field investigation
State File Number:	BFU CX008-13

## Factual Information

During aerobatics close to the ground the aircraft collided with photovoltaic equipment parts and crashed to the ground.

## History of the Flight

On the site of a museum north-west of runway 10/28 in the immediate vicinity of Eberswalde-Finow Airfield (EDAV) a motorsports event took place at the day of the accident.



The museum west of the airfield

Photo: Police

The pilot radioed the Flugleiter (A person required by German regulation at uncontrolled aerodromes to provide aerodrome information service to pilots) saying he intended to conduct a training flight and fly to the museum. The Flugleiter informed the pilot about runway 28 in use as follows: Wind from south-west with 3 - 4 kt and no traffic at the airfield. Afterwards there was no more radio contact between the Flugleiter and the pilot. The Flugleiter stated that he had no knowledge of any aerobatics programme the pilot intended to fly. At 1204 hrs<sup>1</sup> the pilot taxied via taxiway A, entered runway 10 (097°), and took off.

<sup>1</sup> All times local, unless otherwise stated.

It was observed that he pulled the aircraft steeply upward after take-off. The Flugleiter stated he had become aware of the events later when he noticed black smoke and a fireball from the corner of his eyes.

After take-off the pilot flew aerobatics in the area of the museum which could partly be reconstructed with the help of witness' statements and several video recordings.

Sequence of the aerobatics prior to the accident:

- 2:04 min.: The pilot flew westbound and then a stall turn to the right, followed by a Cuban eight.
- 01:30 min.: West of the audience stand he conducted a stall turn to the right.
- 01:10 min.: After a low pass along the audience he conducted another stall turn to the right east of the stand.
- 00:53 min.: Back on a western heading, he flew two slow rolls thereby passing the audience.
- 00:45 min.: Finishing the roll he headed south.
- 00:32 min.: In a wide turn to the right the pilot flew toward the audience stand once more coming from the west and thereby rolling the aircraft up-side down.
- 00:13 min.: He flew up-side down passing the audience heading east. The estimated height was approximately 20 to 50 m at a lateral distance of approximately 20 m.

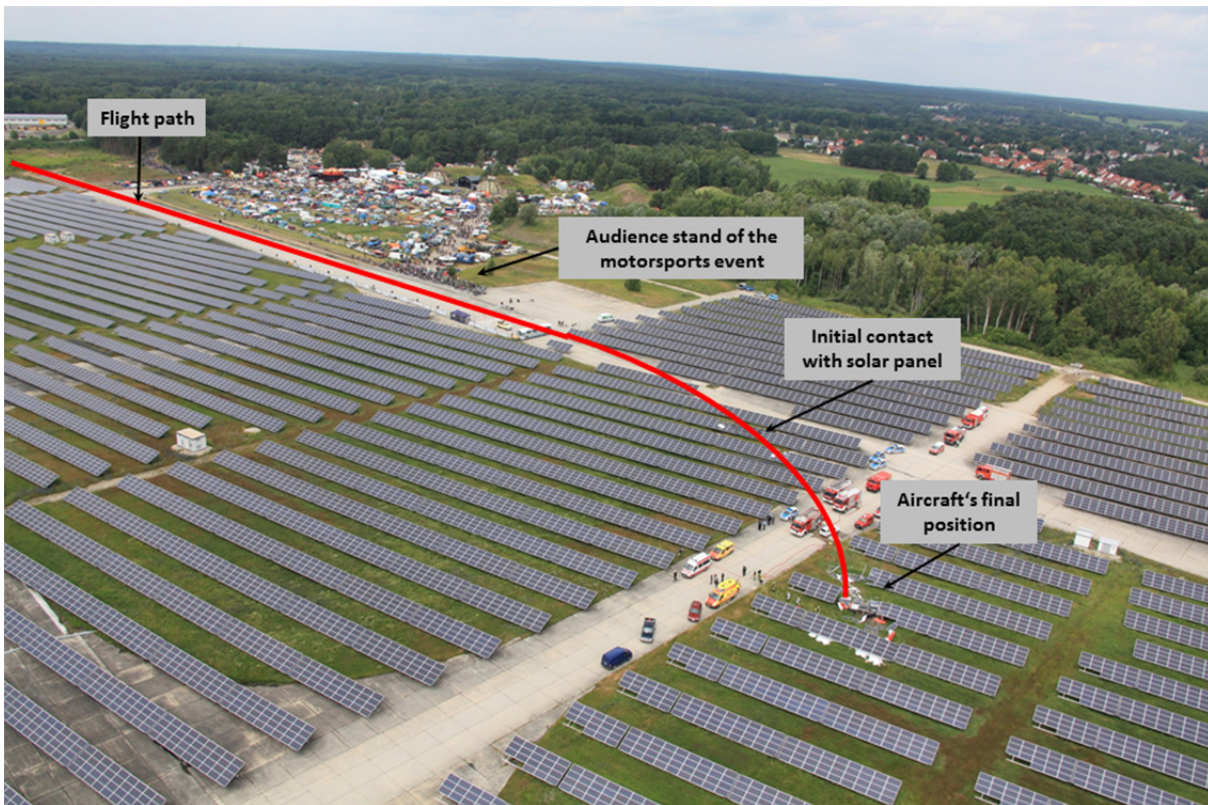


Pass along the audience

Source: Bystander video, adapted by BFU

00:02 min.: The Pilot attempted to recover normal flight attitude by conducting a half slow roll to the left. In doing so he veered right by approximately 20°.

0:00 min.: The wing tip tank of the right wing collided with the solar panel and exploded.



Reconstructed flight path and accident site

Photo: Police, adapted by BFU

After the initial collision, the aircraft inverted and crashed into several solar panels on the ground. The pilot was fatally injured and the aircraft destroyed.

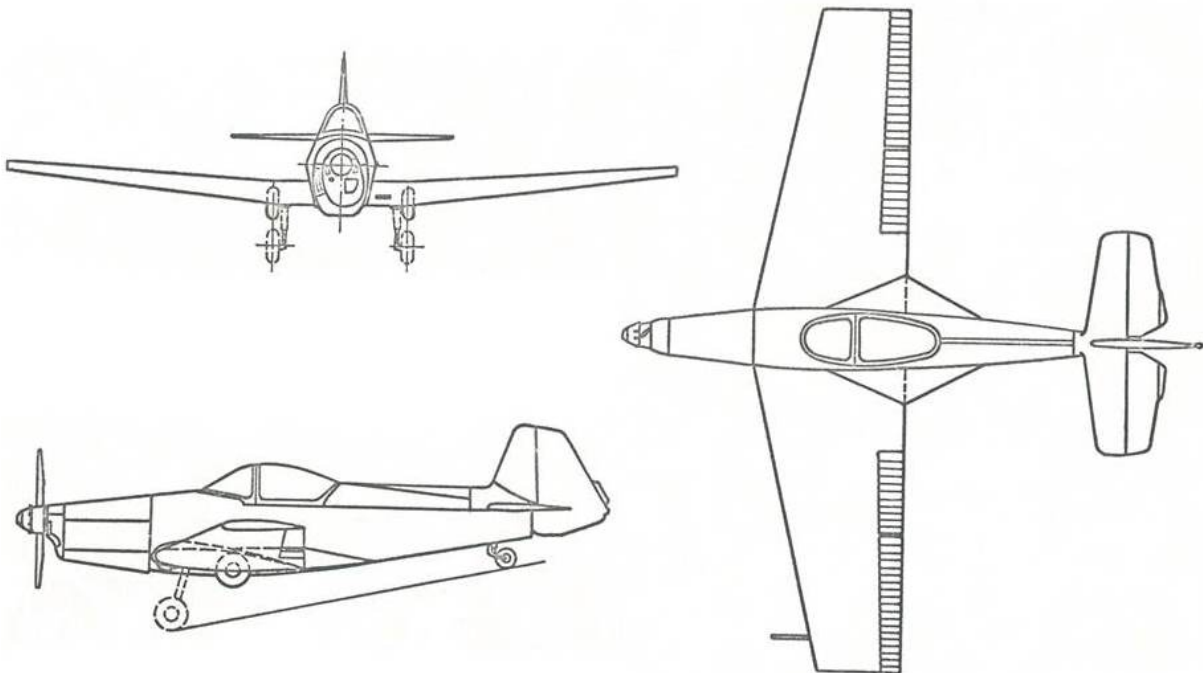
## Personnel Information

The 47-year-old pilot held a pilot's licence for glider pilots since 15 June 1982. His Private Pilot's License (PPL), issued in accordance with ICAO, was valid until 10 March 2015. He held the rating as Pilot in Command (PIC) for Single Engine Piston land (SEP land); valid until 13 February 2014. His licence also carried the entries for aerobatics, aero tow with in-flight pick-ups, and night flight qualification. His language proficiency level 4 was valid until 31 December 2010. His EU Part FCL licence issued on 20 June 2013 was valid until 30 June 2016 and carried the flight

instructor rating FI(A). His class 2 medical certificate was valid until 16 May 2015. The last pilot log book entry was of 13 October 2012. His total flying experience up until then was 3,127:55 hours and 10,445 flight cycles.

## Aircraft Information

The Zlín Z-526 AFS-V is a single-seated sports and aerobatics airplane of the Trenér series and was built in former Czechoslovakia. The fuselage consists of a welded steel tube structure. Top and bottom were covered with metal and the sides with fabric. The twin-spar wings were mounted to the fuselage in cantilever low-wing configuration. The tail section consisted of a metal frame covered with fabric. The wheels of the main landing gear could be retracted halfway into the wings. The aircraft was equipped with a suspended Avia-6-cylinder in-line engine M-137 A with 132 kw (180 hp) and twin-blade variable pitch metal propeller. Additional fuel tanks could be fitted to the wing tips.



Three-view drawing Zlin 526 AFS without additional fuel tanks

Source: Zlin / BFU

The aircraft was built in 1967 and had a certificate of registration of the Czech Republic. The last aircraft log book entry regarding the operation of the aircraft in the Czech Republic was of 24 November 2012 at 3,284:19 operating hours and 18,243 flight cycles.

On 29 March 2013 the aircraft was sold to a German citizen. The new owner (accident pilot) received all documentation issued in Czech and the Czech flight handbook.

The BFU had a Czech insurance policy from 1 April 2013 until 1 May 2013 available. The contract of purchase noted the new owner had requested that the aircraft should be promptly removed from the Czech aircraft register. Up until the day of the accident such an application was never filed.

According to the main flight book the first landing at Eberswalde-Finow Airfield was on 15 April 2013. Until 21 May 2013 flights in Germany and to Poland were conducted with this aircraft from Eberswalde-Finow Airfield on six days.

## Meteorological Information

The aviation routine weather report (METAR) of 1052 UTC of Berlin-Tegel Airport approximately 22 Nautical Miles (NM) away read:

METAR EDDT 291020Z 21009KT 9999 SCT026 BKN120 19/12 Q1014 NOSIG

Wind:	210°/ 9 kt
Visibility:	10 km or more
Cloud cover:	3-4/8 in 2,600 ft; 5-7/8 in 12,000 ft
Temperature:	19°C
Dewpoint:	12°C
Barometric air pressure (QNH):	1,014 hPa
NOSIG:	No significant change

## Radio Communications

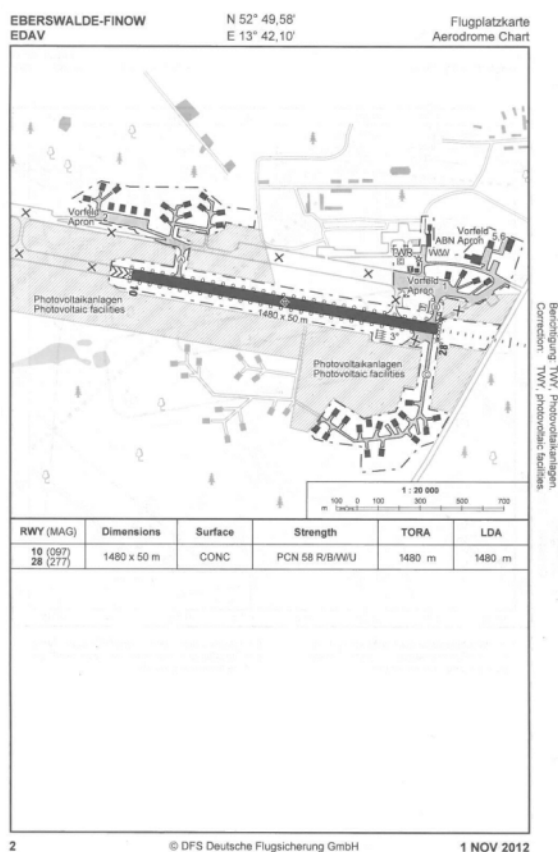
There was radio contact with Finow Info on frequency 119.050 MHz. The radio communications were not recorded.

## Aerodrome Information

Eberswalde-Finow Airfield is located 1 NM south-west of Eberswalde city and is run by an operator corporation. The concrete runway is oriented 10/28 (097°/277°) and is 1,480 m long and 50 m wide. Among other things, it is certified for powered aircraft of up to 14,000 kg take-off mass. In both directions Take-Off Run Available (TORA) and Landing Distance Available (LDA) are 1,480 m. Landing direction 28 is equipped with a Precision Approach Path Indicator (PAPI) with a glide slope of 3°.

The south traffic circuit for powered airplanes is published with 1,000 ft AMSL at an aerodrome elevation of 116 ft.

Several ground-mounted photovoltaic systems are installed in the immediate vicinity of the airfield.



Aerodrome chart

Source: DFS

## Flight Recorders

The aircraft was not equipped with a flight data recorder or a cockpit voice recorder. Neither recorder was required by relevant aviation regulations.

## Wreckage and Impact Information

The accident site was located at a fenced in field with solar panels approximately 100 m north and approximately 700 m west of the threshold of runway 10 of Eberswalde-Finow Airfield. The aircraft was lying in inverted position among the solar panels. The airplane fuselage pointed in the direction of about 180°. The canopy was destroyed and the upper part of the cockpit was bent into the fuselage's welded steel tube structure. The cover panels of the fuselage's upper side were torn open between cockpit and tail section. The vertical tail had been torn from the fuselage and was compressed. The left elevator had been severed from the tail section and lay right of the fuselage's end. The right horizontal stabiliser was bent backward. The main landing gear was retracted.



Accident site

Photo: BFU

The power lever and the mixture controller were found in the forward position. The engine fuel shut-off valve was open.

The examination of the fuel tanks showed that the left wing tank had been torn open and no longer contained any fuel. The right wing tank was undamaged and contained a low amount of fuel. The collector tank with a capacity of about 5 l was undamaged and empty. The left wing tip tank was empty and the front part destroyed. The right wing tip tank was also destroyed. Some parts of it were found a little distance from the initial contact of the aircraft with the solar panels. Both wings had been severed approximately 1 m from the wing root and were found approximately 5 m in front of the fuselage in impact direction.

The propeller including hub had been torn off and was found approximately 5 m from the fuselage in the grass. Both propeller blades showed wave-like deformations. The engine mountings were deformed and partially fractured. The oil tank was destroyed and the ground contaminated with oil.

The backrest of the pilot's seat was fractured and the lower part where the parachute should have been was filled with foam. The parachute was missing.

All markings for the levers and switches in the cockpit were in Czech.

## Medical and Pathological Information

According to the post-mortem examination, the pilot suffered severe blunt force trauma mostly to the head and ribcage. At the time of death there was no influence of alcohol or drugs.

## Fire

The initial point of contact with the solar panels occurred with the right wing tip tank of the aircraft. The fuel spraying from this tank ignited. There was no fire on the aircraft. The fire brigade used chemical foam at the area of the engine as a precautionary action.

## Survival Aspects

The pilot collided with the solar panels at head level while the airplane was in the inverted position. Due to the injuries sustained during the impact the accident was non-survivable.

## Organisations and their Procedures

### Minimum Safe Height

The Luftverkehrsordnung (LuftVO) (Air Traffic Order) Para 6 stipulates the minimum safe height, minimum height for VFR cross-country flights as follows:

*(1) Aircraft shall not be flown below the minimum safe height except when necessary for take-off and landing. Minimum safe height is the height at which unnecessary noise disturbance according to § 1 paragraph 2 or undue hazards to persons and property are unlikely to occur in the event of an emergency landing. Over cities, other densely populated areas, industrial plants, assemblies of persons, accident sites and disaster areas, this height shall be at least 300 metres (1,000 ft) above the highest obstacle within a radius of 600 m, and elsewhere at least 150 m (500 ft) above ground or water [...].*

### Minimum Height Acrobatic Flights

Air Traffic Order Para 8 stipulates acrobatic flights as follows:

*[...]*

*(2) Acrobatic flights are prohibited at heights of less than 450 m (1,500 ft), as well as over cities, other densely populated areas, assemblies of persons, and airports. The local competent aeronautical authority of the Federal State may grant exemptions in individual cases.*

*(3) Acrobatic flights conducted in the vicinity of uncontrolled aerodromes require permission by the aviation supervision office in addition to the ATC clearance required according to § 26. This does not affect paragraph 2.*

## Additional Information

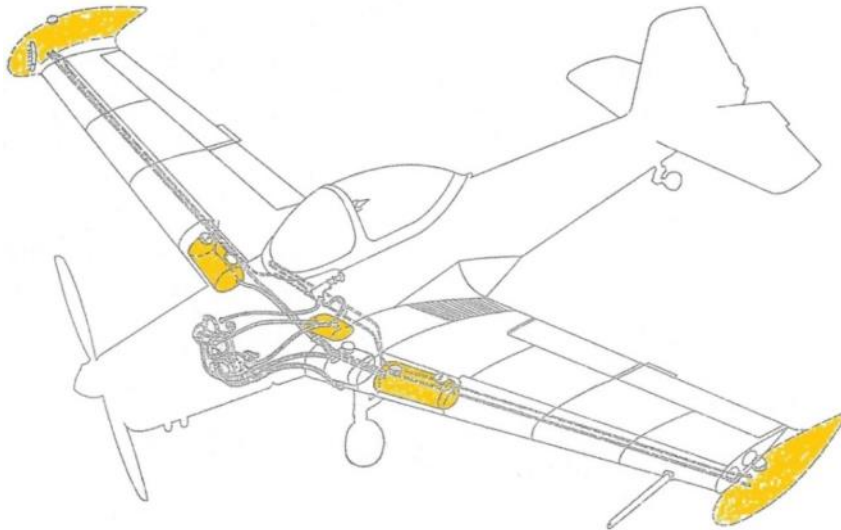
### Fuel System

The engine was equipped with a fuel system especially designed for aerobatics. The fuel system consisted of two main tanks in the wings with a capacity of 35 l each and a collector tank with a capacity of 5 l.

Additional wing tip tanks with a capacity of 35 l each could be fitted. These were designed for normal flight operations.

Excerpt from the flight manual item 1.5.4 translated into German (and now into English). Wing tip tanks:

*By mounting the wing tip tanks the airplane passes from an aerobatics category airplane to a normal category airplane.*



Three-view drawing Zlin 526 AFS without additional fuel tanks

Source: ZLIN/BFU

#### Operating Mode of the Fuel System in Normal and Aerobatics Category:

Due to gravity the fuel flows from the main tank to the collector tank. In normal operation the fuel pump draws fuel from the collector tank through the valve and forces it through a strainer. The fuel is delivered to the fuel injection pump via a fuel vapour separator. Excess fuel together with fuel vapours are routed back into the collector tank. The collector tank is ventilated by a one-way check valve into the left wing tank and then via a connecting line into the atmosphere.

In the inverted flight position, the one-way check valve prevents the fuel from returning to the main tanks. During this flight phase the collector tank does not receive any fuel from the main tanks. Once normal flight attitude is regained the collector tank receives fuel from the main tanks again.

The business partner of the accident pilot stated that the aircraft was fuelled with car fuel from canisters.

## Engine Examination

The BFU seized the wreckage. In the course of further investigations the engine was partially dismantled by a maintenance organisation. No evidence of mechanical malfunctions prior to the accident was found.

The spark plugs of cylinders 1 to 3 were light brown and the ones of cylinders 4 to 6 very light. The fuel and oil filters mounted to the engine were clean and showed no abnormalities. Evidence of lack of lubrication at the engine and its attached parts could not be determined. If the gravity valve, regulating the engine oil supply in the inverted flight position, functioned properly could not be determined due to the destruction of the oil tank.

The inner part of the fuel injection pump, regulating the fuel pressure, was totally dry before and after the valve. The injection lines were opened behind the injection pump. Only the line for cylinder 1 carried a small amount of fuel. All other lines were dry.

The examiner estimated that the engine had been in good technical condition.

## Useful or Effective Investigation Techniques

A photo taken by a bystander showed a change in colour of the exhaust fumes shortly before the collision (photo below).



Pass along the audience

Source: Bystander video, adapted by BFU

## Analysis

The aircraft was not airworthy and had no valid German certificate of registration. The buyer did not de-register the aircraft with the Czech authorities. The flight manual and the markings in the aircraft were exclusively in Czech.

After 1 May 2013 there was no more liability insurance for the aircraft. According to the flight manual the airplane was no longer certified for aerobatics since the wing tip tanks had been fitted.

Flying an aerobatics programme above the motorsports site was probably owed to self-portrayal and occurred on his own accord. Below 450 m such a programme should never have been conducted. In addition, performing such a programme in the vicinity of crowds would have made a permit of the responsible authority necessary.

Despite the afore-mentioned regulation, the aerobatics were conducted without permission of the Luftaufsichtsstelle (local aviation authority) in close proximity to an airport. The Flugleiter did not explicitly forbid the aerobatics programme.

The aerobatics programme was conducted without emergency parachute.

It was not possible to determine the fuel quantity because the aircraft was fuelled with car fuel filled into canisters.

The empty collector tank found at the accident site indicates that the engine was no longer supplied with fuel. It cannot be ruled out that the engine failed in the inverted position. An indicator for it was the slight colouring of the engine exhaust fumes immediately prior to the collision. The pilot tried to conduct a half roll from the inverted position to regain normal flight attitude.

According to video recordings the elevator was slightly pulled during the knife edge flight phase of the half roll to the left. Therefore the aircraft veered right prior to the collision. Because the rudder was either in neutral or slightly right during the 90° bank angle, the fuselage pointed approximately 5 to 20 degrees down and the aircraft lost altitude. Due to the very low altitude and an error in control inputs the wing tip tank grazed parts of the photovoltaic system.

Loss of control of the aircraft was the result and it crashed into the solar panels in inverted position. Even in normal flight attitude the pilot would not have had a chance to conduct an emergency landing in terrain free of obstacle due to the low altitude.

## Conclusions

The accident was due to:

- Engine performance was impaired due to lack of fuel during inverted flight.
- The error in control inputs during the roll back to normal flight attitude resulted in the collision with solar panels and subsequently the ground impact.

The pilot's decision to conduct aerobatics in close proximity to the ground contributed to the accident.

Investigator in charge: Holger Röstel

Field investigation: Kalinka, Schell, Hennig

Braunschweig, 21 July 2015

This investigation was conducted in accordance with the regulation (EU) No. 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and the Federal German Law relating to the investigation of accidents and incidents associated with the operation of civil aircraft (*Flugunfall-Untersuchungs-Gesetz - FIUUG*) of 26 August 1998.

The sole objective of the investigation is to prevent future accidents and incidents. The investigation does not seek to ascertain blame or apportion legal liability for any claims that may arise.

This document is a translation of the German Investigation Report. Although every effort was made for the translation to be accurate, in the event of any discrepancies the original German document is the authentic version.

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