Investigation Report

Identification

Type of Occurrence: Accident
Date: 1 August 2014
Location: Bremen
Aircraft: Airplane
Manufacturer / Model: Koniklijke Maatschapij de Schelde / Saab 91B "Safir"
Injuries to Persons: Two persons fatally injured
Damage: Aircraft destroyed
Other Damage: Damaged buildings and vehicles
State File Number: BFU 3X080-14

Factual Information

At 1244 hrs\(^1\) the airplane took off from runway 09 at Bremen Airport for a commercial flight in accordance with Visual Flight Rules. One pilot and one other person were on board. Shortly after take-off the airplane crashed to the ground.

\(^{1}\) All times local, unless otherwise stated.
History of the Flight

According to the radio communications recordings the pilot requested at 1239:11 hrs taxi information and departure via mandatory reporting point November. The air traffic controller suggested the following, which the pilot accepted: “[…] will be taxiway Charlie enough for you, take-off run available one one four zero meters.” Subsequently, the controller instructed taxiing via taxiway C until holding point runway 09: “[…] taxi to holding point runway zero niner via Charlie.” In due course the pilot received departure route and take-off clearance. At 1244 hrs the pilot acknowledged the instruction and clearance and the airplane took off.

According to the radar data recording (Figure 1) the airplane was at 300 ft AMSL after take-off, when at 1245:30 hrs, the pilot contacted the Tower with: “[…] we need to land immediately.“ The Tower controller answered right away: “Roger, pattern is up to you, wind from the south, you may make a teardrop and land runway two seven, if you like.”

By chance, one witness documented the last part of the flight with photos. He stood about 900 m east of threshold 27 and slightly north of the extended centre line.
Figure 2: Airplane during take-off climb

Figure 2 depicts the airplane with retracted landing gear, flaps in position zero (so-called clean configuration), and opened cowl flap (at the side in the area of the engine cowling).

Figure 3: Airplane turning

Figure 3 shows the airplane in a left-hand turn with about 30° bank angle. The aileron and the elevator are in almost neutral position; the rudder is deflected slightly left.
In the course of the left-hand turn around the longitudinal axis the aircraft nose has dropped lower (Figure 4). The ailerons are deflected right; the elevator is in the nose-up position, and the rudder in neutral.

![Diagram of aircraft attitude](image)

Figure 4: Flight attitude shortly before impact with the ground  
Source: D. Schulz/actionpress, adaption BFU

Immediately after the airplane stalled it impacted the ground about 0.5 Nautical Miles (NM) north-east of the threshold of runway 27.

Both occupants were fatally injured. The aircraft was destroyed.

**Personnel Information**

The 47-year-old Pilot in Command (PIC) held an Airline Transport Pilot's License (ATPL(A)) of the European Union issued in accordance with Part FCL on 1 April 2014. On 28 January 1992 it was first issued as national licence.

The privileges of the licence included radio transmissions in German and English for flights in accordance with Visual or Instrument Flight Rules (VFR or IFR) and the following ratings:

- A330 PIC/IR valid until 30 September 2014
- A340 PIC/IR valid until 31 March 2015
His class 1 medical certificate was valid until 30 November 2014.

According to his pilot log book he had a total flying experience of 13,169 hours. Of these 847 hours were flown in single-engine aircraft (SEP(land)), which also included a number of single-engine classic aircraft. He had an aerobatics experience of 44 hours and a flying experience on helicopters of 92 hours.

In the last 12 months he had flown approximately 714 hours. Of these about 600 hours were flown on A330/340 and about 55 hours on JU-52. Approximately 59 hours he had flown on two helicopters and 13 on other aircraft types (classic, aerobatics, single and twin-engine aircraft (land) and seaplane).

In the last 15 months the pilot had flown 16 hours on type at 16 cycles. In the last 90 days he had flown six cycles. The last operator's proficiency check on type was conducted on 12 April 2014. According to a witness no stall or approach to stall attitudes were flown.

A 72-hour medical history was compiled. According to the statement of the interviewed person, the pilot did not have any occupational commitments and had spent a relaxed time at home with his family. In this time period his private flying time had been limited to 45 minutes with a Stampe & Vertongen SV-4 (classic single-engine aircraft land).

Aircraft Information

General Description and Aircraft Data

The airplane (Figure 5) is a low-wing aircraft in all-metal construction with retractable landing gear and one engine. The wings are partially and the rudder entirely covered with cloth. According to the Type Certificate Data Sheet minimum crew is one pilot.
Manufacturer: Koninklijke Maatschapij de Schelde, Dordrecht, Netherlands
Type: Saab 91B "Safir"
Manufacturer's Serial Number (MSN): 91.291
Year of manufacture: 1954
Max. take-off mass: 1,165 kg
Total airframe hours: 7,815 hours
Engine type: Lycoming O-435A
Propeller: Hartzell HC-12V20-8D-8433-B

The aircraft had a German certificate of registration and was operated by a German operator.

The operator had transferred the responsibility for the continuance of the airworthiness of the aircraft to a maintenance organisation certified in accordance with Part-M, Section G.

The last Airworthiness Review Certificate (ARC) was issued on 31 March 2014. According to the mass report of 13 March 2014 the aircraft had an empty mass of 840 kg.
The maintenance of the aircraft was performed in accordance with Regulation (EU) No. 2042/2003 Part M.A.302. On 19 March 2014 the last 100-hour check had been issued at an operating time of 7,795 hours.

According to the statement of a witness and the reconstruction of the loadsheet of this flight Dry Operating Mass (DOM)\(^2\) was 908 kg. The passenger including baggage was estimated at 87 kg. The fuel on board was calculated with 100 kg. This results in a Take-Off Mass (TOM) of approximately 1,095 kg. Therefore, centre of gravity was at approximately 2,300 mm. According to the mass report the centre of gravity should have been between 2,208 mm (maximum forward position) and 2,510 mm (maximum aft position).

According to the aircraft manual stall speed is approximately 65 kt given the determined conditions (TOM 1,095 kg, clean configuration, 30° bank angle).

**Meteorological Information**

The aviation routine weather report (METAR) for Bremen Airport at 1250 hrs stated: Wind from 200° at 7 kt, varying wind directions between 140° and 250°, visibility of more than 10 km, no clouds below 5,000 ft AGL and clouds and visibility okay (CAVOK). No significant changes were expected within the stated time period.

The photos of the course of the accident (Images 2 - 4) showed that at the time of the accident Cumulus clouds had formed.

**Aids to Navigation**

The BFU had the radar data recordings of a German air traffic service provider available for evaluation (Image 1).

Based on the radar data mean airspeed above ground was approximately 68 kt during climb and the subsequent level flight, which lasted about four seconds.

\(^2\) Dry Operating Mass (DOM) is identical to Basic Operating Mass (BOM) and consists of basic mass (aircraft empty weight including standard items and a certain amount of unusable fuel and engine oil), the mass of crew (pilot) and crew baggage (pilot)
Radio Communications

Radio transmissions between the airplane and air traffic control at Bremen Airport were recorded. The transcript contains the time period between 1239:03 hrs and 1245:33 hrs.

The relevant content of the radio transmissions are part of the chapter History of the Flight.

Aerodrome Information

Bremen Airport (EDDW, BRE) is located 2 NM south of the city centre of Bremen. Aerodrome elevation is 14 ft AMSL. Bremen Airport has one asphalt runway with the orientation 087°/267° (09/27). The runway is 2,045 m long and 45 m wide. It also has one asphalt runway with the orientation 231° (23), which is 700 m long and 23 m wide.

After taxiing on to runway 09 via taxiway C, take-off distance available was 1,140 m.

Wreckage and Impact Information

Accident Site

The accident site was located within an industrial park on a paved parking area between a row of garages and a storehouse for tyres. In front of the storehouse stood a freight container, which also served as storeroom for tyres. The space between the buildings was 17.40 m.
A ground marking, which could be associated with the propeller-engine-unit, was identified as impact point. The direction of motion after the impact was 283°. Approximately 9 m after the impact point the airplane had collided head on with the freight container. The final position of the airplane corresponded with the impact direction.

Aircraft

The engine was lying left in front of the fuselage. The oil filler pipe was open; the cap was jammed between the two cylinders of the engine. The threads of the oil filler pipe and of the cap did not show any damages. The oil level gauge, which was not connected with the cap, was correctly inserted in the oil filler pipe.
One blade of the two-blade propeller had been torn off.

Both wings had been severed from the fuselage. The right wing had been folded z-shaped and was lying on the engine. The burnt remnants of the left wing were lying parallel to the fuselage.

The entire empennage had been severed and was lying at the end of the fuselage.

Due to the high degree of destruction it was no longer possible to identify the instrument indications and the positions of the levers in the cockpit.

On 1 September 2014 the primary controls (roll, pitch, yaw) were examined at the BFU in the presence of a representative of the maintenance organisation and the responsible police (Figure 8).
It was determined that due to the high degree of destruction it is not possible to make a statement regarding the serviceability of the controls during the accident.

On 16 June 2015 the BFU conducted additional examinations on the engine. It was not possible to perform an engine run-up on a test stand because the crankcase and the housing of the forward crankshaft bearing were destroyed by impact forces. The ignition system, the oil pipes, the fuel system, and the intake system were destroyed by fire. The crankshaft and the connections with the con-rod were not damaged.

The boroscopy of all six cylinders showed the following:

- The intake and outflow valves showed no disruptions.
- The running surfaces of the cylinders did not show any grooves or so-called scoring marks.
- A foreign object of 2 x 2 mm was found in the combustion area of cylinder No 1. Several 1 mm large chip-like foreign objects were found in the combustion area of cylinder No 3. A gelatinous drop-shaped mass was found in the combustion area of cylinder No 4.
- The pistons showed a typical surface with no disruptions.

All spark plugs were of a light grey colour. The electrodes of the spark plugs showed slight wear.
The examination of the engine showed the following:

- Due to damage the extent of the examination was limited.
- The colour of the spark plugs and the condition of the electrodes indicated a proper mixture setting. The condition of the electrodes allowed proper function.
- There were no indications of damages on the crank drives and the valves.
- The surfaces did not show any signs of so-called piston jamming.
- Due to size, the foreign objects found in the combustion areas were not suited to cause engine failure.
- The gelatinous mass could be fire extinguisher residue.
- There was no evidence of lack of lubrication.

Medical and Pathological Information

The post-mortem examination performed on both occupants on behalf of the prosecutor's office determined multiple trauma a cause of death. There were neither indications regarding a so-called smock gas inhalation nor previous illnesses.

Fire

After the crash the airplane had caught fire. The fuselage, the left wing, and the empennage were destroyed by fire.

The aircraft fire set the two wheel storages and several vehicles in the parking area on fire.

According to airport ground operations of Bremen Airport the fire brigade reached the accident site 90 seconds after it had been alerted by the Tower controller.

According to the mission report of the municipal fire brigade Bremen they had been alerted at 1248 hrs and reached the accident site at 1253 hrs. At 1431 hrs the fire was under control. At 1458 hrs the fire was extinguished. Subsequent pollution measurements and further extinguishing of pockets of embers extended the mission until 2219 hrs. During this time period a total of 69 fire vehicles had been deployed. A total of 99 persons were involved in the fire fighting.
Additional Information

Operator

The operator conducted VFR commercial passenger transport with the Saab 91B. The managing director stated that the annual operating time of the airplane was approximately 40 hours.

According to the Flight Operations Manual (FOM) Part A, as of 1 April 2008, the postholder operations ensured that the company pilots were deployed in accordance with their ratings at the most on three different aircraft types or series which according to the type certificate data sheet shall be flown with at least one pilot. For pilots, who worked for other companies in commercial passengers transport, this included the types and series flown there. According to the FOM-A, when changing from one aircraft type to the next, the respective pilot was responsible to make himself sufficiently familiar with the differences regarding handling of the aircraft type.

The FOM-A also contained information regarding the Operator Proficiency Check (OPC). It was stipulated that each flight crew member had to be subjected to an OPC to show that normal, abnormal, and emergency procedures could be performed.

The Safety Management System (SMS), as of 30 June 2014, contained under Item 2.0: "Basis of an effective Safety Risk Management is the identification of hazards in flight operations, the investigation of their influence and subsequently the risk analysis and the mitigation of the hazard potential (Risk Assessment and Mitigation)."

Photos of the Airplane

According to witness statements the airplane was photographed at the apron from different angles prior to the flight. Therefore it's position was changed several times. At one point the position was changed with the help of the engine. The tow bar still in place at the nose landing gear was dragged along during taxiing. A witness signalled the pilot and was able to make him aware of the problem. The pilot shut off the engine.

The tow bar showed skid marks, but no propeller marks (Image 9).
Figure 9: Blank metal indicating the skid marks on the handle of the tow bar (yellow)

Source: BFU
Analysis

The pilot held the required licences and ratings to conduct the flight as PIC. He had a valid medical certificate and there were no indications of health impairments. The medical history did not reveal any indications that the pilot had not slept enough or started the day stressed.

The aircraft had a proper certificate of registration. Take-off mass and centre of gravity were within prescribed limits. Due to the high degree of destruction the technical examination was limited and did not allow any conclusions as to the failure of components and the control system. The examination of the engine did not reveal any signs of engine failure or power loss.

The BFU could not determine without doubt at what point the oil filler cap had been removed, but considers it as highly likely that the pilot removed it during the mandatory oil level check as part of the pre-flight check. It is conceivable that he inserted the oil level gauge into the pipe after having checked the oil level and then forgot to screw the cap back on.

The tow bar, which had been dragged along during re-positioning of the aircraft did not cause any damage to the propeller.

At the day of the accident visual meteorological conditions prevailed and there were no specific weather phenomena. Due to the summery weather (high air temperature, high dewpoint difference, wind from southern directions) and the orographic conditions (accident site is border region between green areas and urban area) there were good to very good conditions for thermal lift. Especially the clouds in Images 2 to 4 support this assumption.

The BFU is of the opinion that due his being an airline transport pilot and his private flying activities, the pilot had a broad experience. This means he could analyse hazards and deduce the respective actions. On the other hand, the BFU is of the opinion that hazard analysis requires current training regarding the type-related control of abnormal flight attitudes, especially their avoidance. The BFU doubts that with such an extent of flying tasks on different aircraft types and series the pilot was capable to sufficiently take into account all safety aspects. The training of abnormal flight attitudes on the accident type was obviously not sufficient and had not been part of the last proficiency check flight with the Saab 91B.
The BFU is of the opinion that the company should have intervened as part of their safety risk management and aimed at realisation or catching up on the proficiency check and the respective training of abnormal flight attitudes.

Take-off climb was aborted at about 300 ft AMSL. The BFU considers it most plausible that the abortion of the take-off climb was due to oil vapours from the open oil filler and/or oil spray settling on the cockpit windscreen.

The analysis of the radar data and the photos determined that the airplane had been in horizontal flight attitude and in clean configuration prior to the initiation of the left-hand turn. The mean air speed during take-off climb calculated from the radar data was about 68 kt. It is probable that it did not increase significantly during the horizontal flight lasting only a few seconds. Therefore it was only slightly above stall speed for the turn with about 30° bank angle. Stall speed was probably reached through additional increase in bank angle under the possible influence of vertical gust. Relative to the bank angle minimum speed was undercut which resulted in stall to the left.

If he had had the respective type-related training it is possible that the pilot would have been able to recognise the hazardous situation.

The BFU is of the opinion that the available time and altitude were not sufficient to stabilise and flare the aircraft after the stall.

Conclusions

The air accident is ascribable to the pilot not considering the necessary speed required for the turn when he made the decision to turn left and therefore the aircraft entered an uncontrolled flight attitude.

The BFU assess a possible distraction from the control of the aircraft due to the perception of oil vapours and oil spots on the windscreen as contributing factor.
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 - FlUUG) 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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