

# Investigation Report

## Identification

Type of Occurrence: Accident

Date: 11 September 2019

Location: Gransee

Aircraft: Airplane

Manufacturer: Cessna Aircraft

Type: C 208 Caravan

Injuries to persons: Pilot fatally injured

Damage: Aircraft destroyed

Other Damage: Crop damage

State File Number: BFU19-1272-3X

## Abstract

During final approach and a wide descent turn at low altitude, the airplane crashed to the ground.

## Factual Information

### History of the Flight

At 1448 hrs<sup>1</sup>, the pilot took off from Gransee Special Airfield with the Cessna 208 Caravan to a commercial flight in accordance with visual flight rules. On board were the pilot and 15 skydivers, which were dropped at flight level 130.

On this day, the pilot had already conducted three flights dropping skydivers with a total flight time of 48 min.

After having dropped the skydivers during the fourth flight, the airplane was last captured by the radar at 1505:49 hrs, during approach to land at the airfield, close to the accident site at about 550 ft AMSL. At the time, ground speed was 168 kt and heading 330°. The Flugleiter<sup>2</sup> stated that he had observed the last phase of the approach. The airplane had been in a left-hand turn with a bank angle of up to 90° close to the ground. He assumed that the pilot might have “overshot” the extended centre line of runway 29 when he entered the final approach coming from the south. Then the airplane had vanished behind the trees. The pilot did not transmit an emergency call. The Flugleiter also stated that with the previous flight he had witnessed a similar manoeuvre.

The radar recording of the third flight ended at 1417:54 hrs with a recorded altitude of about 1,400 ft AGL. At the time, ground speed was 168 kt and heading 355°.

During both flights the skydivers had been dropped at flight level 130 at a heading of about 300° south of the airfield. After dropping the skydivers, at 1415:07 hrs and at 1502:52 hrs, respectively, the airplane entered a descent with a very high rate of descent and flew in a wide left-hand turn back to the airfield. During the third flight a right-left-hand turn with bank angles of about 50° to 60° (Fig. 1) occurred during descent.

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

<sup>2</sup> A person required by German regulation at uncontrolled aerodromes to provide aerodrome information service to pilots

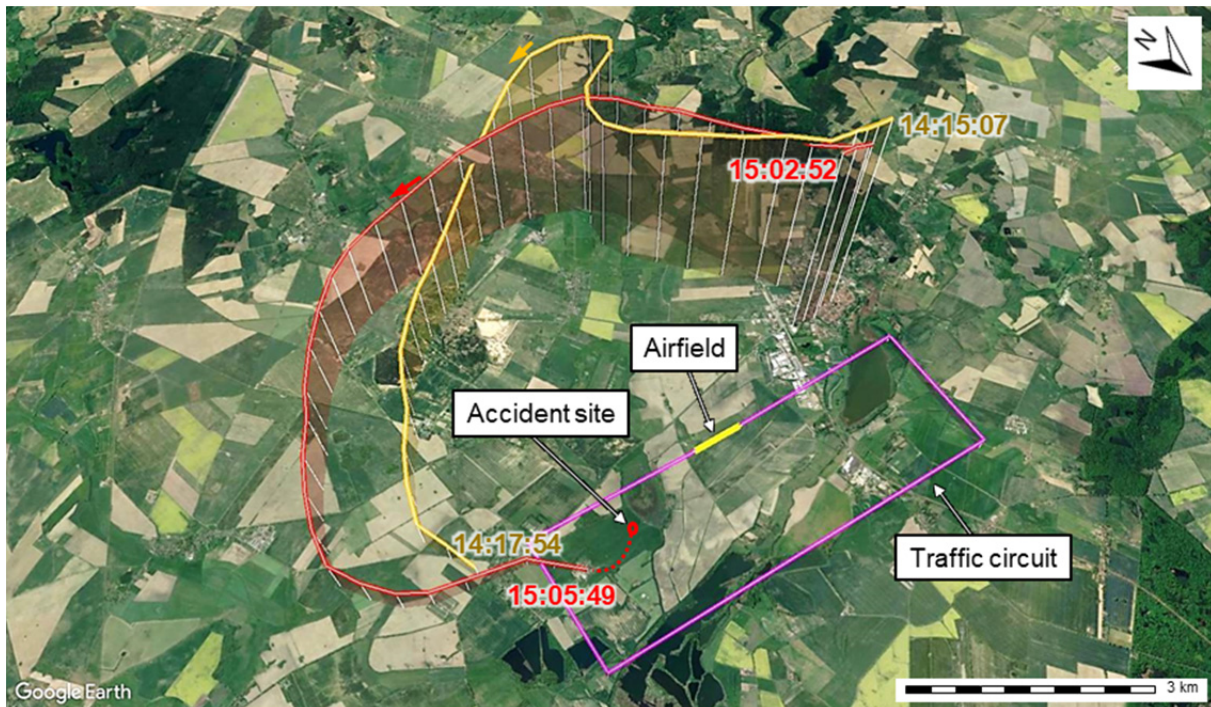


Fig. 1: Accident flight (red) third flight (yellow)

Source: Air navigation service provider, German Armed Forces, and Google Earth™, adaptation BFU

## Personnel Information

The 32-year-old pilot was Hungarian citizen and held a Hungarian Commercial Pilot License (CPL(A)) since 2007. The licence was last issued on 8 March 2019 in accordance with Part-FCL of the European Union and listed the following ratings:

- SET(land)<sup>3</sup>, valid until 28 February 2021
- SEP (land), valid until 31 March 2021
- TMG, valid until 31 March 2021
- NVFR, no expiry date

He had acquired the rating SET (land) on 22 February 2019<sup>4</sup> on Cessna 208. He was trained at the operator for whom he conducted the skydiving operations. His supervision occurred in Spain in March 2019 and the familiarisation of the airfield at the be-

<sup>3</sup> Single Engine Turbine

<sup>4</sup> Date of the check flight

ginning of the skydiving season 2019 with the operator's post-holder operations at Gransee Special Airfield.

His class 1 medical certificate without restrictions including commercial single pilot operation was valid until 28 February 2020.

According to his pilot log book, he had a total flying experience of 1,553 hours and 3,776 cycles, of which 1,380 hours were conducted as pilot in command. Between 17 March 2019 and 11 September 2019 he had flown 288 hours and conducted 1,053 cycles with a Cessna 208. In the last 90 days he had conducted 676 landings.

According to the main log book, the pilot had conducted 1,000 cycles at Gransee Special Airfield.

After the end of his shift the previous week, he had flown by scheduled services from Berlin to Hungary for an appointment and arrived at about midday on the day of the accident also by scheduled services at Berlin and Gransee, respectively, and began his flying duties right away.

## Aircraft Information

The Cessna 208 was a high-wing turboprop aircraft in all-metal construction with fixed landing gear in nose wheel configuration (Fig. 2).

The airplane involved was equipped with a 4-blade variable-pitch propeller. The cargo door on the left-hand side of the cabin was equipped with a so-called roll-up cabin door for dropping skydivers.

The aircraft had a German certificate of registration and was operated in commercial specialised air operations in accordance with Regulation (EU) No. 965/2012.

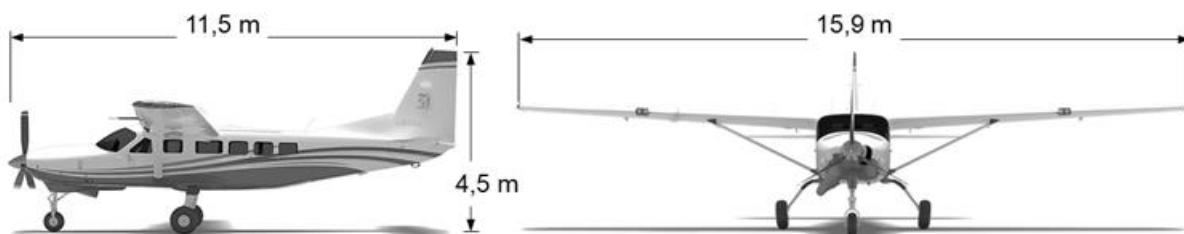


Fig. 2: Two-way view of the standard configuration Cessna 208 of the manufacturer

Source: Website of the manufacturer, adaptation BFU

Manufacturer:	Cessna Aircraft
Type:	C 208 Caravan
Manufacturer's Serial Number (MSN):	20800301
Year of Manufacture:	1999
Engine type:	Honeywell TPE331-12JR-702TT
Propeller type:	Hartzell HC-B4TN-5QL/LT10891NK
Empty weight:	2,131.5 kg
Maximum take-off mass:	3,792.0 kg
Total Operating Time:	4,066 hours (4,983 cycles, 7,660 landings)

On 5 July 2019, the airplane was subject to an ACAM<sup>5</sup> check. There were no findings.

The last Certificate to Release to Service<sup>6</sup> was issued on 21 August 2019 at an operating time of 4,021:23 hours and 7,468 cycles.

A flight mass of about 2,340 kg was determined for the time of the accident. It consisted of the empty mass, the remaining fuel of about 100 kg, the mass of the pilot of about 107 kg and a low and not quantified mass of papers on board. The centre of gravity determined was within limits.

According to the POH<sup>7</sup>, the following procedure was stipulated after dropping the skydivers:

1. *Ice Protection (if installed) – as required*
2. *Pitot/Static Heat – on when OAT<sup>8</sup> is below 5 °C (40 °F)*
3. *No Smoking/Seat Belt Sign Switches (if installed) – as required*
4. *Altimeter – Set*
5. *GPS/NAV Switch – Set*
6. *Power – as required to give desired rate of descent*

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<sup>5</sup> Aircraft Continuing Airworthiness Monitoring

<sup>6</sup> Certificate of Release to Service: Statement signed by an licensed Aircraft Engineer, with asserts that the aircraft is airworthy to the degree appropriate for safe flight (Source: SKYbrary)

<sup>7</sup> Pilot Operating Handbook

<sup>8</sup> Outside Air Temperature, the free air static temperature

According to the POH, the airplane was limited to a  $V_{MO}^9$  of 175 KIAS. Given the flight mass,  $V_A^{10}$  was about 120 KIAS.

In preparation for the landing the following limitations had to be adhered to, according to the POH:

- *Wing Flaps 0° to 10° below 175 KIAS*
- *Wing Flaps 10° to 20° below 150 KIAS*
- *Wing Flaps 20 to 30° below 125 KIAS*

The POH listed the following speed recommendations for the approach to land:

- *Flaps Up 95 - 110 KIAS*
- *Flaps Full Down 75 - 85 KIAS*

## Meteorological Information

The aviation routine weather report (METAR) of 1450 hrs of Berlin-Tegel Airport, located approximately 50 km south of Gransee, published the following weather data: Wind direction 220° at 11 kt. Wind direction was variable between 190° and 250°. Visibility was more than 10 km; there were no clouds below 5,000 GND and no weather phenomena (CAVOK). The temperature was 21°C, dewpoint 6°C, and QNH 1,021 hPa.

At the time of the accident, the solar altitude was 35.48° and the direction 218.40°. Sun set was at 1933 hrs.

## Radio Communications

The pilot was in radio contact with the Flugleiter of Gransee Special Airfield. Radio communications were not recorded.

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<sup>9</sup> Maximum Operating Speed, the speed that may not be deliberately exceeded at any time (= VNE, Red Line)

<sup>10</sup> Manoeuvring Speed, the maximum speed at which full or abrupt control movements may be used without overstressing the airframe

## Aerodrome Information

Granse Special Airfield (EDUG) is located approximately 3 km east of Gransee city. According to the approval certificate of 24 March 2014, the special airfield had one grass strip with a length of 750 m and a width of 40 m in the directions 110° and 290° (11/29) and has an altitude of 51.3 m NHN<sup>11</sup>. Landing and take-off distance available in both directions was 750 m. The runway was embedded in a safety area with a length of 810 m and a width of 60 m. The runway strength allowed operation of aircraft of up to a maximum take-off mass of 5.7 t MTOM.

A standard traffic circuit (Fig. 3) was stipulated for flight operations in accordance with VFR.

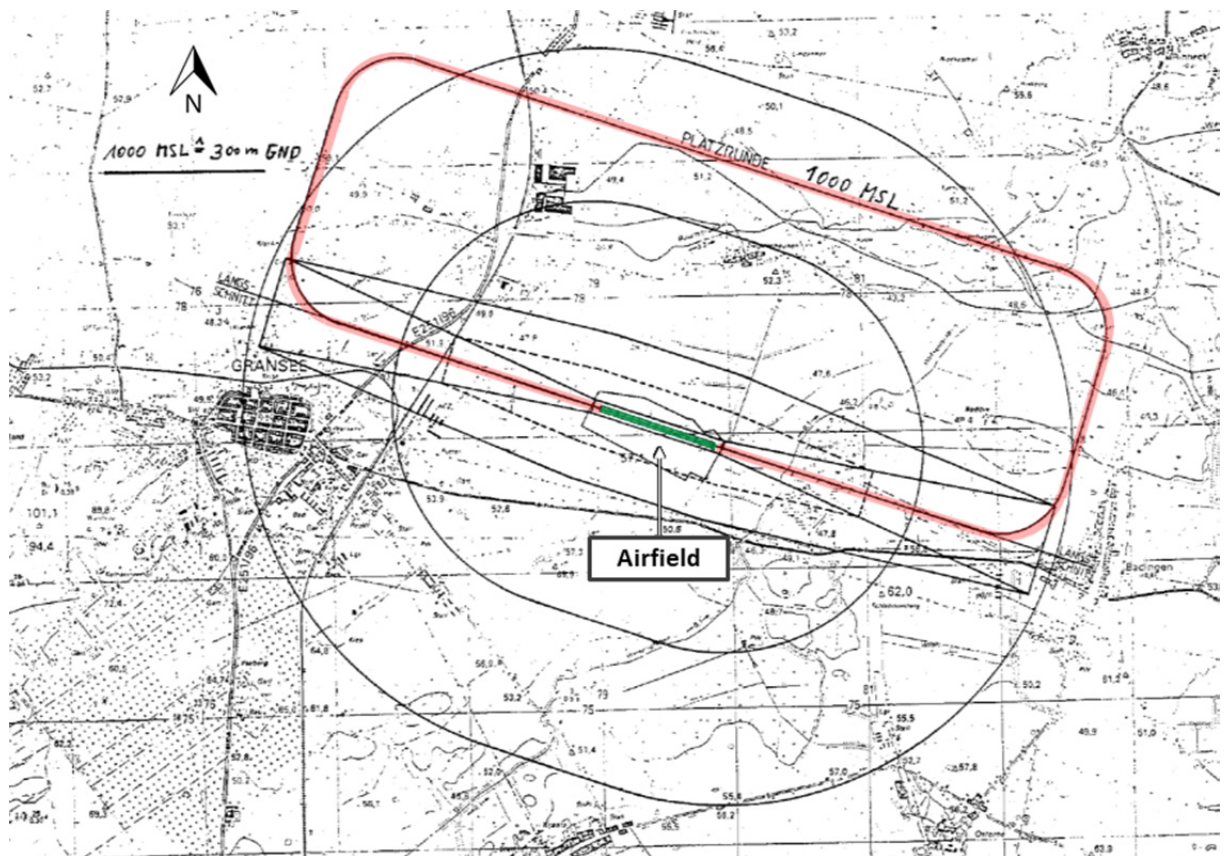


Fig. 3: Traffic circuit

Source: Official approval certificate, adaptation BFU

<sup>11</sup> Standard Elevation Zero

## Flight Recorder

The BFU was provided with the radar data of the air navigation service provider and the German Armed Forces for evaluation purposes.

The radar data<sup>12</sup> of the accident flight had been recorded between 1450:09 hrs and 1505:49 hrs. For the analysis, the time after the skydivers were dropped at 1502:52 hrs at about 13,000 ft AMSL until the end of the recording at 1505:49 hrs (recorded altitude about 550 ft AMSL) was examined (Fig. 4).

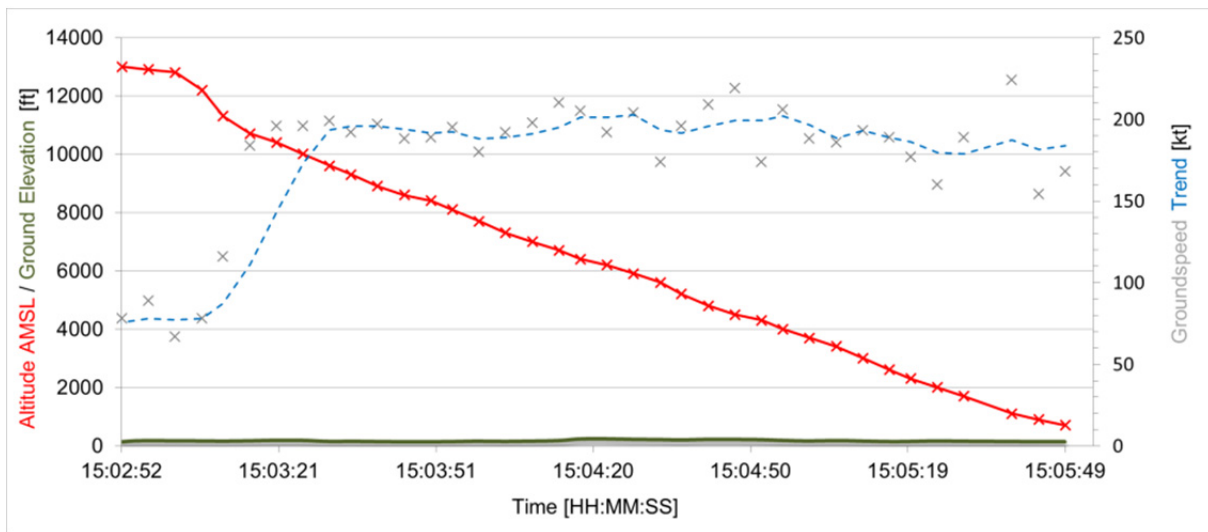


Fig. 4: Depiction of the descent and the speed between 1502:52 hrs and 1505:49 hrs

Source: Air navigation service provider, adaptation BFU

Below 10,000 ft AMSL, the airplane reached ground speeds between 180 and 200 kt. The mean rate of descent was 4,000 ft/min.

Based on the radar points and the direction of the impact traces, the flight had a circular arc with a radius of about 575 m prior to impact. Assuming a speed of about 168 kt (310 km/h or 86 m/s) the required mean bank angle was about 53° (Fig. 5).

<sup>12</sup> The radar data was recorded at Berlin-Tegel Airport.



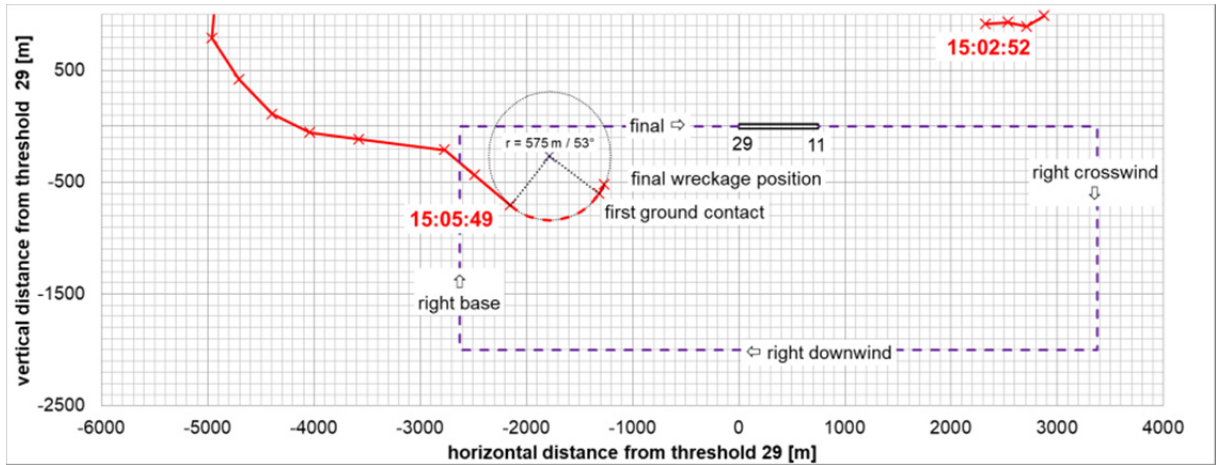


Fig. 5: Analysis of the accident scenario

Source: BFU

## Wreckage and Impact Information

The accident site was located 1,250 m east of the threshold of runway 29 of Gransee Special Airfield and about 530 m north or to the right of the extended centre line, respectively, at approximately 50 m NHN on an area with low vegetation (Fig. 6).

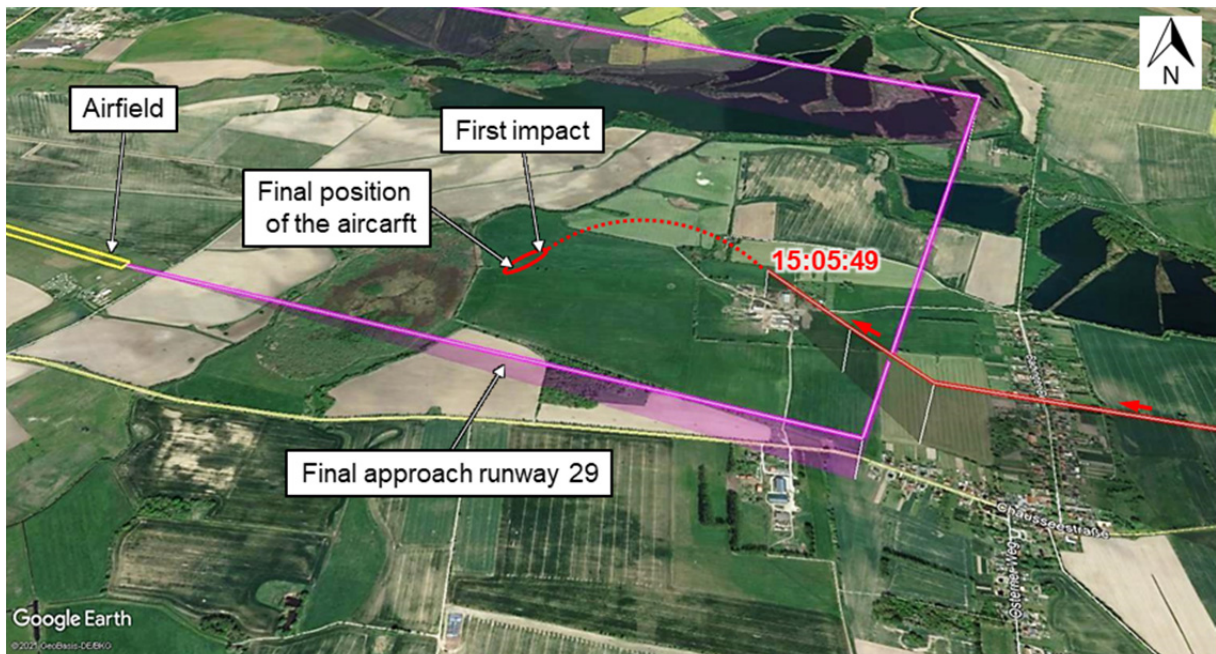


Fig. 6: Location of the accident site

Source: Google Earth™, adaptation BFU

The ground traces<sup>13</sup> proceeded over a distance of 90 m in 230° (Fig. 7).

The first impact trace could be correlated with the main landing gear. At the beginning of the extended earth deposit, which could be correlated with the impact of the nose, five propeller impacts with a distance of about 50 cm and a depth of 10 cm were determined.

The final impact occurred at the counter slope of a drainage ditch at a single tree.



Fig. 7: Ground traces at the accident site

Source: Police, adaptation BFU

The instrument panel, parts of the cockpit including the pilot seat, and the engine had separated from the main wreckage and were lying 10 m behind the wreckage in impact direction. The propeller was lying left of the main wreckage.

The fuselage structure had been destroyed. The roll-up cabin door of the cargo door was found in the open position.

<sup>13</sup> The documented ground traces, which could be correlated with the occurrence, consisted of fresh damage to the turf and earth deposits.

The left wing tip of about 1 m length and the left aileron had been torn off. The flap and the main part of the left wing, the right wing including aileron and flap were connected with the fuselage.

Examination of the rudder, elevator and aileron controls was possible only to a limited extent due to the destruction. The rods and rope connections could be retraced in the tail section and both outer areas of the wings; they were connected.

The examination of the flap control determined that the flaps were in the retracted position.

The reduction gear of the turboprop had fractured; one part was still attached to the propeller hub. The engine inlet showed black sticky deposits which could be identified as dirt and oil film. The drive shaft could be rotated freely. On the first stage of the axial compressor nine blades were bent; the last turbine stage was undamaged. The combustion chamber housing showed a crack; there were no traces of fire. On the engine panel, it was not possible to determine the power setting.

Due to the destruction, it was not possible to determine the propeller blade position.

At the altimeter, a QNH of 1,022 was selected.

At the accident site, all aircraft components could be identified.

The lamps of the indicator light of the annunciator panel were microscopically examined. Some filaments had fractured in cold condition. A significant elongation could not be determined with any of the lamps.

## Medical and Pathological Information

The post-mortem examination determined that the pilot had died due to impact consequences. Evidence of pre-existing illnesses was not found. There was no alcoholisation or impairment by narcotics or toxicological agents.

## Fire

There was no evidence of fire in flight or after the impact.

## Organisational and Management Information

The company conducted commercial air operations: Parachute Dropping Operations<sup>14</sup>.

The Operations Manual (OM Part C)<sup>15</sup> stipulated the following:

- *2.5. Performance*

*Normally, an aircraft used in skydiving activities is operated for economic reasons at the maximum of its capacity. For this reason and under normal circumstances all climb and descent operations will be close to but not above the maximum performance values as described within the POH. Clearly, there are requirements upon aircraft and upon aviation personnel which are unique to the kind of skydive operation. For example, what is considered an aerobatic maneuver by a pilot flying a Boeing 757 with passengers might be considered a routine maneuver to quickly lose altitude in an empty jump aircraft in order to pick up the next load of jumpers waiting on the ramp. However, the airplane must be flown smoothly and must remain within the performance envelope of the jump aircraft at all times.*

*For that reason, it is extremely important that the pilot will permanently remain to monitor all engine, speed and attitude indicators to stay at all times less or within but not above the maximum limits.*

- *2.6.4 Descent and Landing*

*[...]*

*b) Descent attitude and airspeed must remain within the performance envelope of the jump aircraft as determined by the aircraft manufacturer and applicable POH.*

*c) [...] Turns during descent should be kept to a minimum and descent should be as close to the airport as possible.*

*[...]*

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<sup>14</sup> In accordance with Regulation (EU) No. No. 965/2012 ORO.DEC.100 (Part SPO) of 14.02.2017

<sup>15</sup> Standard Operating Procedure - Parachute Dropping Operation, as of 19.01.2018

The airport rules governing the use of Gransee Special Airfield<sup>16</sup> stipulated the following:

- *1.5 Insofar the rules governing the use empower the airport operator to issue directives and instructions for airport users, this empowerment is also effective for persons who the airport operator authorised or commissioned with the management of traffic and operation of the airport (Flugleiter).*
- *2.6.2 Overflying areas sensitive to aircraft noise in the vicinity of the airfield is to be avoided. In order to achieve this, particular attention should be paid to the traffic circuit during approaches and departures. [...]*

## Additional Information

### Flight Operations Regulations

The following generally binding rules apply for flight operations, among other things<sup>17</sup>:

- *The published flight operations regulations are [...] to be adhered to and therefore fundamentally binding. Deviations especially due to meteorological, traffic-related and technical reasons or because of performance characteristics of the aircraft are permissible.*
- *Normally, the approach is flown into the downwind leg and departure from the base leg.*
- *Approach and departure procedures should only be stipulated if it is essential due to safety reasons.*
- *Straight and level flight (approach of the extended runway centre line) and direct approaches (approach from variable positions direct to the final approach) and direct departures are possible for economic and noise abatement reasons, if aerodrome traffic permits.*

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<sup>16</sup> The airport rules governing the use of Gransee Special Airfield, Part II Usage Regulations, as of 01.12.2018

<sup>17</sup> According to NfL II 27/00 Elementary laws of the Federal Government and the Countries regulating air traffic at airports without air traffic control units

## Additional Information Concerning the Pilot

Since spring of 2019, the pilot had been working for the company. As a start, he had been scheduled for the entire skydiving season 2019.

According to the post-holder operations, he had sufficient experience in skydiving operations and was very flexible; little additional training was required. These advantages were decisive for him getting chosen, after he had shown interest in the job on his own initiative.

He was paid a fixed price per skydiving operation.

For the skydiving season, the pilot had been living in a trailer at the airfield. He spent his free days at Gransee. He rarely travelled to his home country.

The postholder operations described him as friendly, self-reliant, interested in flight operations and dedicated. According to witnesses, the pilot spent a lot of time at the airplane, especially with aircraft care. Even at night he was busy in the hangar, sometimes until the early morning even after long flight operation days.

Four administrative offence actions of the Bundesaufsichtsamt für Flugsicherung (Federal Supervisory Authority for Air Navigation Services) versus the pilot were pending. According to these, he repeatedly violated aeronautical regulations with the Cessna 208 as pilot in command between 25 May and 29 June 2019 when dropping skydivers during VFR flights with take-offs and landings at Gransee. He did not obtain an air traffic control clearance of the air traffic control unit responsible before entering airspace E in order to drop skydivers at flight level 80 or 85. Contrary to the issued and acknowledged air traffic control clearance, he descended to lower flight levels in airspace C without obtaining clearance for such a deviation from the air traffic control unit. The postholder operations and the pilot were aware of these administrative offence actions.

The Bundesaufsichtsamt für Flugsicherung had informed the Regierungspräsidium Stuttgart (regional council) about these rule violations. On 6 August 2019, the regional council contacted the operator to advise them of *“serious violation, which can trigger significant flight operational threats and imperil life and limb of third parties”*. The operator was *“strongly advised to instruct the pilot once again in regard to the flight operational procedures, to stipulate new procedures if applicable, to support the pilot with his work and to reduce his workload so that capacities for other required tasks such as the correct exercise of radio communications are available. If necessary, it would be recommended to conduct another supervision flight with the pilot.”*

The postholder operations stated that he had once again spoken with the pilot and tried to resolve the incidents. Subsequently, a mobile phone ban had been implemented especially during flights, since distraction had been suspected. In addition, he had given the pilot a code of behaviour in regard to the acceptance, the comprehension and the implementation of air traffic clearances.

Shortly before the accident another talk as warning and caution had taken place, because on 3 September 2019, the postholder operations had received an email with a list of complaints from the head of skydiving operations, the tandemmaster and several skydivers and customers:

- *Almost every night (especially weekends, after a 12 hr day flying) he goes into the hangar and stays until 2, 3 or 4am „working on the plane“...*
- *Information related to jump run or altitude drops has to be communicated 2 or 3 times and once again before drop. On various occasions the initial drop is not as requested.*
- *Flight patterns are irregular, approaches are frequently looking like a fighter jet avoiding missiles, dodging left or right, wing over turns to final.*
- *Takeoffs tend to continue flat and low over the adjacent field and end up with a steep climb rate. As in he lifts off nose high using the engine to take off and not the wings, flattening out straight away and building up speed before later climbing.*
- *Continues to fly close to, or sometimes into cb forming clouds looking for extra lift! I have asked in the past that he avoids clouds completely unless absolutely necessary.*
- *Short landings (resulting in reverse thrust to break) were done without thought of the dry grass runway. This has since been rectified, but only through constant visual inspection of the landings and runway conditions by myself. I feel like I shouldn't have to tell resident pilot how to use the runway, as so to prolong its life span...*
- *Long and very low (over neighboring land) landing approaches are frequent.*
- *Most reactions to turbulence are met with a dramatic response on the controls, this is reported to be somewhat of a constant problem, on one occasion the result ended in everyone on board hitting the ceiling of the plane in an instant, one customer had to receive medical attention from us due to a cut he received on his head from this.*

- *The incident with the loss of the wheel arch cover at altitude (lack of inspection).*
- *Twice forgetting to close the fuel cap (blaming it on a loose screw... in all the years refueling I have never seen this happen).*
- *[...]*

The post-holder operations was in contact with the pilot almost daily, either in writing or by phone; approximately once a month they met in person. According to his statement, the pilot was stressed by personal financial and judicial problems.

The intention was to hire the pilot for the subsequent season as well. The pilot favoured this plan. It was made clear, however, that other incidents or complaints would result in instant dismissal.



## Analysis

### History of the Flight and Accident Scenario

The analysis of the flight path determined that the descent was conducted as a wide turn with a relative constant speed of 180 to 200 kt and a rate of descent of about 4,000 ft/min. Even in the flight phase close to the ground - below 1,000 ft AMSL - speed was still in the area of the maximum allowable value. Up until the end of the radar recording (last recorded altitude: 550 ft AMSL) no significant reduction in rate of descent could be determined.

Up until the end, the determined speed was beyond the operating limitations stipulated in the POH and the OM Part C.

It is highly likely that the minimally possible steep turn to the left, which witnesses had described and been proven by calculation, was the attempt to return to the extended centre line of runway 29. During this manoeuvre speed exceeded  $V_A$  considerably.

According to the traces at the accident site, the impact with the ground occurred from the left-hand turn. The bank angle during impact was low; it is likely that it was approximately  $20^\circ$ . The rate of descent was relatively low and the impact angle very small. This allows the conclusion that a flare had been initiated from the steep turn and with a high rate of descent and the crash had occurred in the middle of this manoeuvre.

The destruction indicates a high speed impact.

### Pilot

The pilot held the required aeronautical licence and ratings and was experienced. Especially the 1,000 cycles at Gransee within about six months represent a high experience in regard to the approach of the airfield.

With this kind of experience, the pilot could have realised that from this position and with the high speed he could no longer establish normal approach.

Because his approaches had often been irregular, performed as steep turns and at low altitudes ("like a fighter jet avoiding missiles") he probably learned during the months of skydiving operations that at Gransee, where there is seldom any aerodrome traffic, he can push his limits without consequences and fly ever riskier manoeuvres.

The company received information concerning the pilot's behaviour through the persons in charge of skydiving operations. Responses concerning the problematic behaviour could occur only belatedly. The mobile phone ban the post-holder operations had implemented, the control of the mobile phone use during flights and the repeated talks had but little effect. The supervision flight recommended to the company did not occur. It is doubtful that another supervision flight would have been the key to success.

If the personal problems reported by the company and his environment contributed to his lack of concentration and therefore to the accident could neither be ruled out nor proven

The BFU is of the opinion that the company could have intervened sooner before the pilot's risky flying style became reinforced.

### Aircraft

The aircraft had a certificate of registration and was properly maintained. Loading was within prescribed limits.

The investigation did not reveal any technical deficiencies of the engine, the controls or other aircraft systems.

### Meteorological Conditions

During the descent turn, towards the extended runway centre line, the wind came from the left and may have aided the deviation from the extended runway centre line. However, the wind conditions did not justify the high-risk flying manoeuvre close to the ground.

Impact direction was 230°. The direction of the sun was about 220° at a position of about 35° above the horizon. It is highly likely that even though the direction was the same, the high sun angle had no glare effect and therefore did not influence the accident.

### Operational Aspects and Procedures

During the previous flight, the Flugleiter had seen a similar manoeuvre. In accordance with the airport rules governing the use, he had the legal competence to advise the pilot about the adherence to the stipulated approach procedure.

At Gransee Special Airfield, only the accident airplane was in use. Since no other traffic was present, it was possible to deviate from the recommendations for approach and departure. A so-called direct approach, in this case to runway 29, was possible and did not constitute a risk. According to the common understanding in regard to the traffic circuit, entering a segment of the traffic circuit - here the final approach - should occur at the determined traffic circuit altitude and with the respective approach configuration. Approach of the traffic circuit or the final approach, respectively, should have been conducted in horizontal flight at 1,000 ft AMSL. The speed prior to reaching final approach should have been below 125 KIAS. Only then would it have been possible for the pilot to configure the airplane safely for the final approach.

The OM Part C only refers to pilots having to pay attention to flying the airplane within permissible limits. It also states clearly that the entire flight or the descent, respectively, shall be flown in the shortest possible time. These requirements can only be fulfilled if an airplane is operated at the maximum permissible operating limitations. The OM Part C does not contain any procedure which describes when a pilot shall establish landing configuration.

## Conclusions

The air accident was due to a risky flight manoeuvre close to the ground which resulted in a controlled impact with the ground.

The speed during the approach exceeded the operations limitations of the airplane. The approach was not stabilized.

Contributing Human Factors:

- Recurrent acceptance of risky flight manoeuvres close to the ground by the pilot (routine violations)
- Overconfidence and insufficient risk assessment of the pilot

Contributing Operational Factors

- Unsuitable wording in the operations manual in regard to approaches after dropping skydivers

## Safety Actions

The company revised Part C of the OM, especially the unsuitable wording mentioned above.

Investigator in charge:	Jens Eisenreich
Field Investigation:	Thomas Karge, Norman Kretschmer
Flight path analysis	Ekkehart Schubert
Analysis Human Factors:	Dr. Susann Winkler
Technical Examination:	Uwe Berndt

Braunschweig, 05 January 2022

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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