

Investigation Report

Identification

Type of Occurrence:	Accident
Date:	26 April 2013
Location:	Bötersen
Aircraft:	Airplane
Manufacturer / Model:	EADS Socata / TBM 700 B
Injuries to Persons:	Four persons fatally injured
Damage:	Aircraft destroyed
Other Damage:	Crop damage
State File Number:	BFU 3X027-13

Factual Information

Take-off was at Kiel-Holtenau Airport (EDHK) in accordance with Instrument Flight Rules (IFR). After a change of flight rules the approach to Rotenburg (Wümme) Airfield (EDXQ) was conducted in accordance with Visual Flight Rules (VFR). During the approach the airplane collided with the terrain and caught fire.

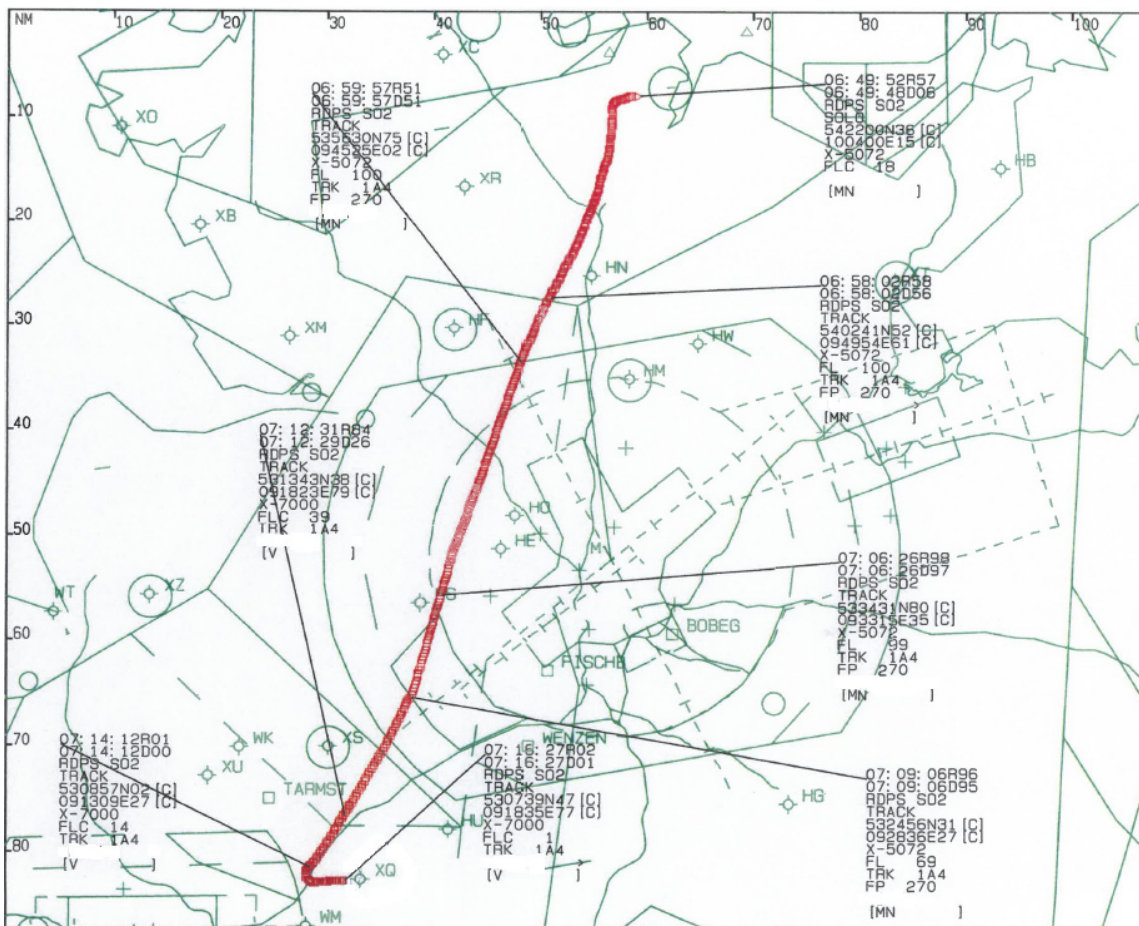
History of the Flight

Two pilots and two passengers were on board the airplane. Two additional persons were to board the airplane in Rotenburg (Wümme). Then the plan was to fly to Friedrichshafen Airport (EDNY) and attend an aviation fair. A landing permit for

Friedrichshafen between 1040 hrs¹ and 1100 hrs had been obtained. The flight plan showed Bremen Airport (EDDW) as alternate aerodrome for the flight to Rotenburg (Wümme).

A witness stated that prior to take-off the person in the right-hand seat had phoned Rotenburg (Wümme) three times asking about the weather conditions. At about 0800 hrs and 0830 hrs this person had asked a passenger waiting at Rotenburg (Wümme) Airfield and at about 0840 hrs the Flugleiter (A person required by German regulation at uncontrolled aerodromes to provide aerodrome information service to pilots) about the weather.

Take-off in Kiel-Holtenau was at 0846 hrs.



Radar data recording of the entire flight path between 0849:52 and 0916:27 hrs

Source: Deutsche Flugsicherung, adapted by BFU

¹ All times local, unless otherwise stated.

According to the recording of the radio transmissions, the airplane was controlled by air traffic control Bremen Radar from 0850:02 hrs on. A clearance was issued for a left-hand turn after the airplane had reached 3,000 ft AMSL and for the direct flight to the omnidirectional radio beacon Elbe (VOR LBE).

At 0850:45 hrs clearance for the climb to Flight Level (FL) 100 was issued. A few minutes later the airplane reached the cleared cruise level.

After the frequency had been changed and the next sector had taken over the controller issued the clearance at 0906:02 hrs to descend to FL 70. At 0908:41 hrs the following instruction was issued: "*[call sign] descend 4,000 feet on QNH 1011 turn right ten degrees [...]*". According to the radar recordings at that time the airplane had reached FL 70 and changed its heading by 10° right.

After another change of frequency the pilot reported at 0911:11 hrs. "*[call sign] passing FL50 descending 4,000 feet 5 miles final Rotenburg 08 will report ready to cancel next.*" At 0912:03 hrs the pilot added: "*[call sign] cancelling IFR now*". At 0912:07 hrs the controller confirmed the change of flight rules IFR/VFR: "*[call sign] IFR part is cancelled 0712 squawk 7000 leaving approved [...]*."

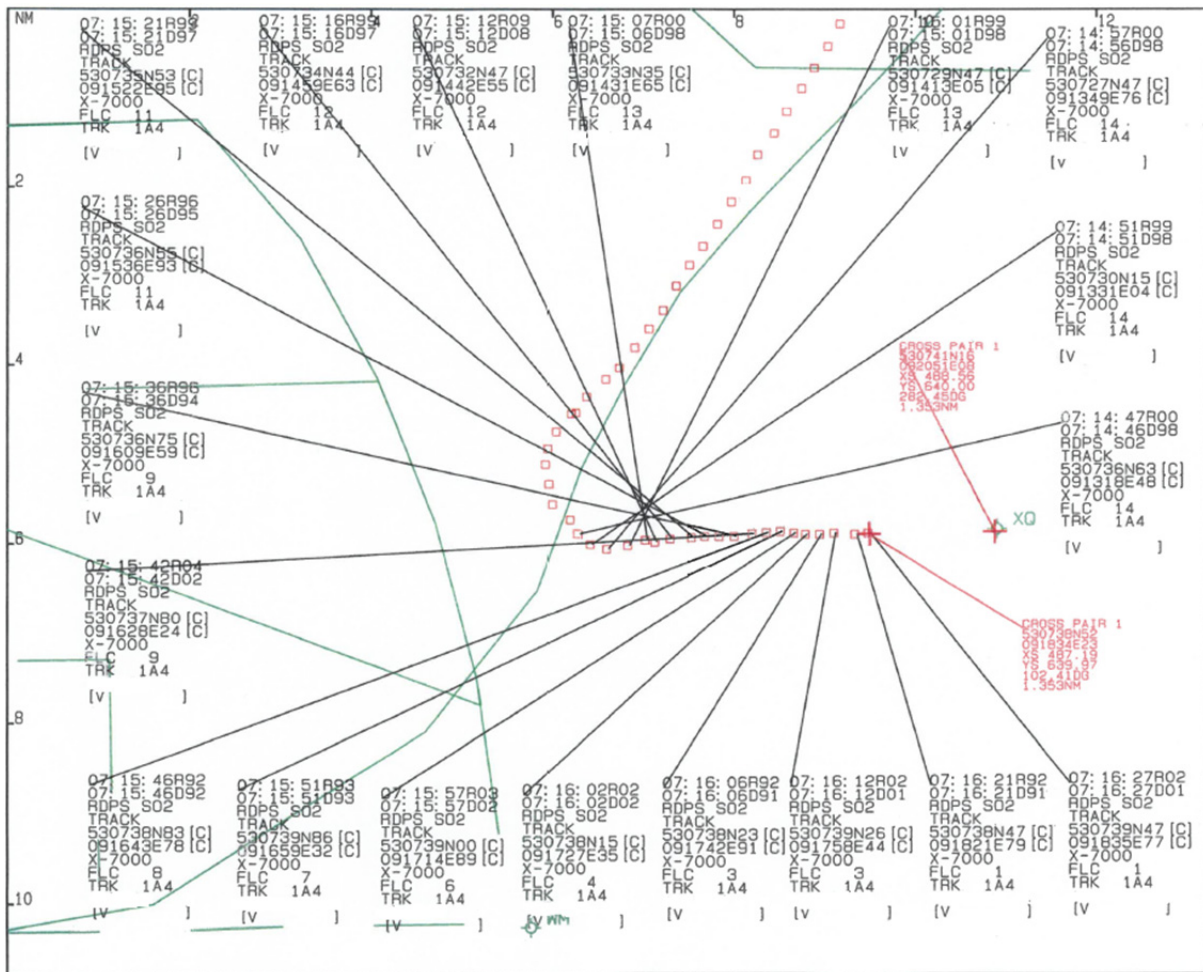
According to a witness statement the person in the right-hand seat had called the destination airport on its Info frequency. At that time the airplane had been approximately 8 Nautical Miles (NM) north of the destination airport at about 4,000 ft AMSL at a heading of about 210°. They were informed that at the airfield visibility was 2 km and the cloud base at 500 ft.

According to the radar data recording the descent had been continued to 1,400 ft AMSL. At 0914:57 hrs a left-hand turn ended in the final approach heading of approximately 090° without further loss of altitude.

From 0915:07 hrs on the airplane began to descend continuously with a heading of 090°. According to the Flugleiter the same person, who had initiated radio contact, reported the final approach.

At 0916:27 hrs the last radar target was recorded with an altitude of 100 ft AMSL.

One of the passengers waiting at Rotenburg (Wümme) Airfield had been at the Flugleiter's office and after the last report of the pilot had gone to the balcony to listen for the airplane. But he could neither see nor hear it.



Flight path recording of the final approach between 0912:36 and 0916:27 hrs

Source: Deutsche Flugsicherung, adapted by BFU

The Flugleiter also stated that at the time of the last report of the pilot the airplane could neither be heard nor seen.

At 1.24 NM ahead of the threshold of runway 08 and approximately 570 m left of the extended runway centre line the airplane collided with the ground. The position of the last recorded radar target is almost identical with the accident site.

The occupants suffered fatal injuries and the aircraft was destroyed.

Personnel Information

Person in the Left-Hand Cockpit Seat

The 61-year-old male person held a European Union Private Pilot's Licence (PPL(A)) issued in accordance with Part FCL. It was initially issued on 18 November 1993 as national licence.

The privileges of his licence included radio transmissions in German and English for flights in accordance with IFR and VFR and the following type and class ratings:

- TBM PIC, IR, valid until 30 September 2013
- MEP PIC, IR, valid until 31 March 2014
- SEP PIC, valid until 30 November 2014, IR valid until 30 November 2013

His class 2 medical certificate with restrictions (VML) was valid until 6 April 2014.

According to the entries in an application for a medical certificate he had a total flying experience of 750 hours; approximately 150 hours of which were flown in the last 24 months.

According to the electronic aircraft log book his flying experience on type since acquiring the TBM rating in September 2011 was 56 hours and 58 cycles.

He owned the airplane involved.

Person in the Right-Hand Cockpit Seat

The 49-year-old male person held a Commercial Pilot's Licence (CPL(A)) in accordance with JAR-FCL German, with the entry ATPL Theory Credit and MCC, initially issued on 17 October 2000 as national licence.

The privileges of his licence included radio transmissions in German and English for flights in accordance with IFR and VFR and the following type and class ratings:

- C525 PIC, IR, valid until 30 November 2013
- Aerospatiale SET, PIC, IR, valid until 31 July 2013, CRI, valid until 30 November 2015
- PC12 PIC, IR, valid until 31 December 2013
- SEP PIC, IR, valid until 29 October 2013, CRI, valid until 30 November 2015
- FI PPL(A), valid until 30 November 2015

His class 1 medical certificate without restrictions was valid until 30 September 2013.

According to his flying records of June 2012 he had a total flying experience of about 3,680 hours. His flying experience in aircraft powered by turboprop engines was about 210 hours; of these 66 hours and 81 cycles were flown on TBM 700.

As needed, he flew the airplane involved as freelance pilot.

Since February 2008 he was also a trainer for Crew Resource Management (CRM).

As pilot he was familiar with Rotenburg (Wümme) Airfield; the Flugleiter of this airfield also knew him. That is why the Flugleiter was able to identify the pilot's voice during radio transmissions.

According to the aircraft log book both pilots had conducted 68 flights together where responsibilities rotated.

Aircraft Information

The aircraft TBM 700 B is a single-engine low-wing airplane in metal construction with low percentage of fibre-reinforced composites, and a retractable landing gear in nose wheel configuration. It is equipped with a turbine (free turbine, reverse flow, two turbine sections) and a propeller (constant speed, feathering and hydraulic control reverse).

The flight handbook states that it is approved for single-pilot operation.

Manufacturer	EADS Socata
Type	TBM 700 B
Manufacturer's Serial Number (MSN):	194
Year of manufacture:	2001
Empty mass:	1,974 kg
Max. take-off mass:	2,984 kg
Max. landing mass:	2,835 kg
Total airframe hours:	1,489 hours (as of 24 April 2013)

Total cycles: 1,299 (as of 24 April 2013)
Engine type: Pratt & Whitney PT6A-64
Propeller type: Hartzell HC-E4N.3/E9083 S (K)

The aircraft had a valid German certificate of registration. It was operated and chartered out by a commercial operator. As needed, a freelance pilot could be procured.

According to the inspection certificate the equipment on board met the requirements for IFR flights. Among other things, the airplane was equipped with two satellite navigation systems Garmin GNS 530 and GNS 430, and a radio altimeter Honeywell KRA 405 B.

The last Airworthiness Review Certificate was issued on 24 April 2013.

Meteorological Information

Meteorological Pre-flight Preparation

The Deutsche Wetterdienst (German meteorological service provider, DWD) stated that for the flight no individual weather information was obtained from one of the Meteorological Advisory Centres for Aviation. A check of the self-briefing system pc-met showed that no weather data was accessed via the user account of the person in the left-hand seat. The person in the right-hand seat did not have a user account at pc-met. According to the witnesses the pilots were aware prior to take-off in Kiel that in Rotenburg (Wümmen) ground visibility was 2,000 m and the cloud base at 500 ft.

Weather forecast

According to the DWD the General Aviation forecast (GAFOR) for the GAFOR areas 00 to 23 and 31 to 36, valid between 0800 hrs and 2000 hrs, issued at 0647 hrs, was:

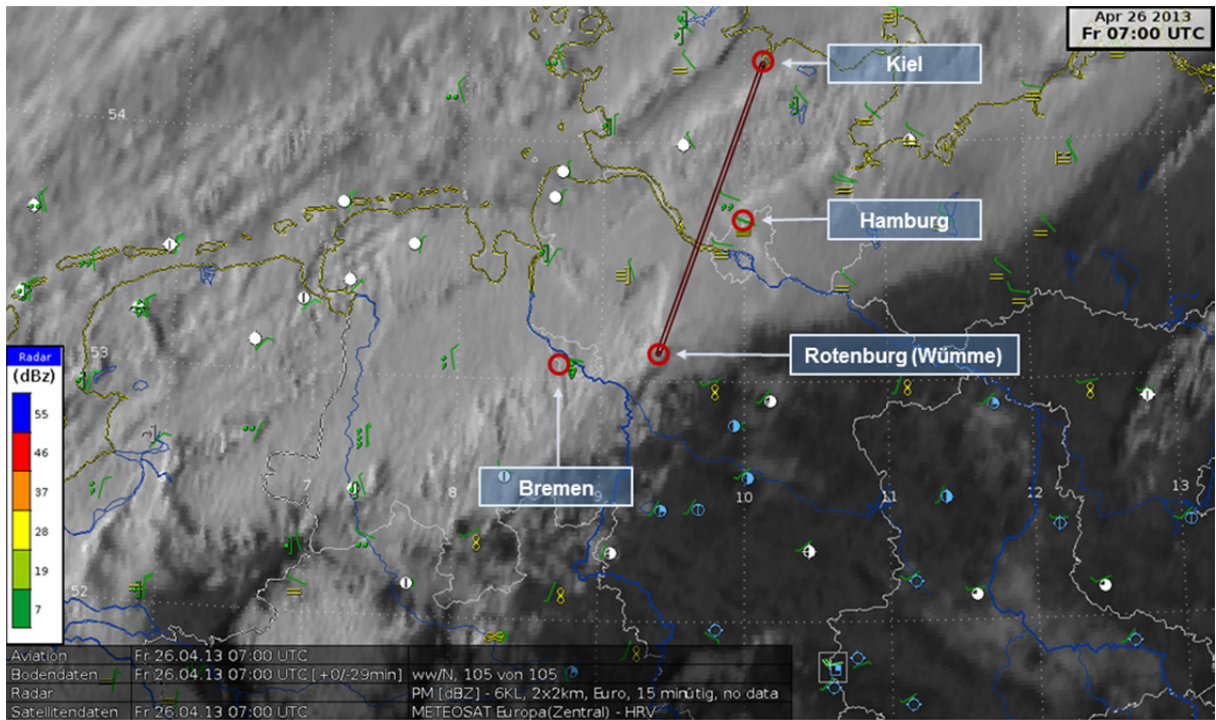
A cold front extended across the northern part of Schleswig-Holstein and the North Sea to the South of England, slowly shifting south-east. Thus, in the morning several layers of broken to closed clouds with lower limits between 1,500 ft and 3,000 ft AMSL and tops up to FL 245 prevailed, in combination with rain and drizzle. In addition, at 400 ft to 900 ft AGL scattered to broken stratus clouds with visibilities between 2 and 4 km prevailed. In front of the front at 100 ft to 600 ft AGL a strip of scattered to broken stratus clouds with tops between 1,000 ft and 1,500 ft AMSL had

formed. In this area visibilities were between 1.5 km and 3 km. Locally fog prevailed with visibilities of a few meters, which cleared only slowly throughout the morning. The forecast of 0500 until 1100 hrs classified the GAFOR area 05 (north-west Lower Saxony) as MIKE 8 (marginal visual meteorological conditions) for the time between 0700 and 0900 hrs. The forecast of 0800 hrs showed XRAY (no visual meteorological conditions) between 0800 and 1000 hrs.

Weather Conditions during the Flight and at the Time of the Accident

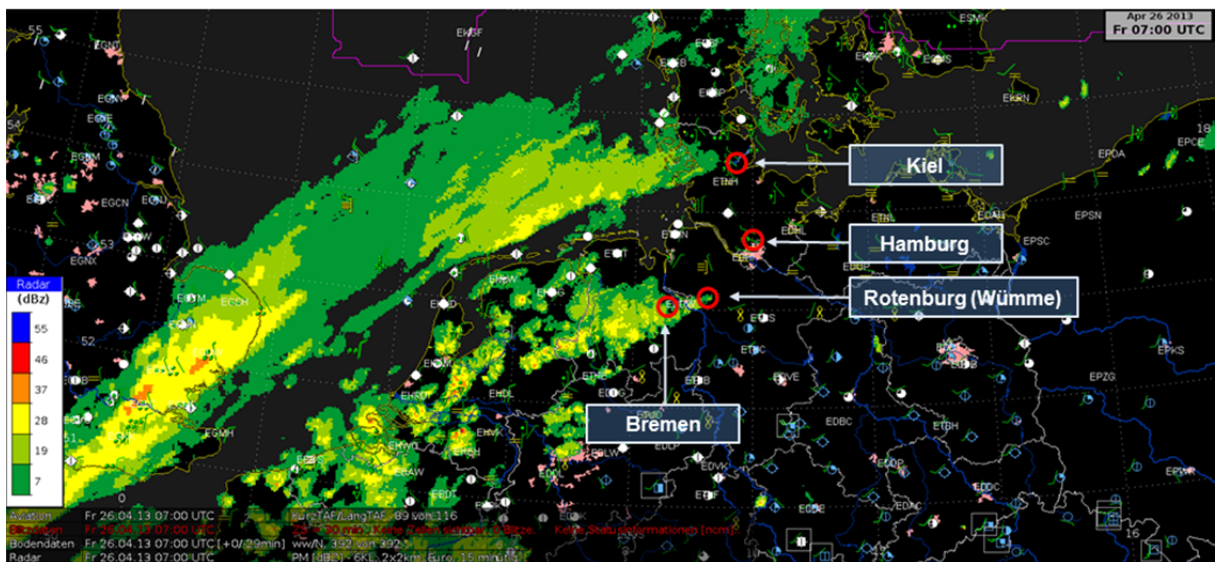
The satellite image of 0900 hrs shows a compact cloud cover from Bremen, to Rotenburg (Wümme), and up to Hamburg.

According to the expert opinion of the DWD the Aeronautical Meteorological Office Bremen reported at 0920 hrs visibility of 2 km and a cloud base with scattered clouds at 200 ft. A pilots report showed another lower limit with scattered clouds at 400 ft AMSL. In addition, there was slight precipitation. According to the measurement of an airplane, which had taken off in Hamburg (AMDAR report), an inversion was present at approximately 3,000 ft AMSL. Below that a very damp base layer with deep stratus clouds and local fog was present. It is highly likely that also above 3,000 ft AMSL compact clouds up to FL 100 and higher prevailed. The weather reports for Bremen and Hamburg were representative for Rotenburg (Wümme).



High-resolution satellite image

Source: DWD, adapted by BFU



Rain radar

Source: DWD, adapted by BFU

Weather Recordings at Rotenburg (Wümme) Airfield

The weather recordings of 0849 hrs contained the following data: Wind 10° with 3 kt; visibility 2,000 m, GAFOR MIKE, clouds 8/8, QNH 1,011 hPa, temperature 10°C, dewpoint 10°C.

Weather Reports of Bremen Airport and Hamburg Airport

The aviation routine weather report (METAR) of Bremen Airport located approximately 20 NM west of Rotenburg (Wümme) of 26 April 2013 at 0820 hrs read:

Wind 330° with 3 kt, visibility 2,000 m, mist, broken clouds at 200 ft GND, temperature 10°C, dewpoint 10°C, QNH 1,011 hPa, temporary rain showers.

The METAR of Hamburg Airport located about 38 NM north-east of Rotenburg (Wümme) of 26 April 2013 at 0820 hrs read:

Wind 290° with 4 kt, visibility 3,200M, mist, broken clouds at 200 ft GND, closed cloud cover at 300 ft GND, temperature 11°C, dewpoint 10°C, QNH 1,011 hPa, visibility improvement in the following 2 hours to 5,000 m and broken clouds at 600 ft GND.

The METARs issued at 0920 hrs of the same sources did not contain any significant deviations from the above-mentioned data.

Weather Observations in the Vicinity of the Accident Site

According to police data ground visibility at the accident site at about 0940 hrs was between 500 m and 700 m. The weather conditions were described as misty, temporary drizzle, and slight wind.

Aids to Navigation

The ICAO Aeronautical Chart 1:500 000, edition March 2013, showed a maximum elevation figure of 700 ft AMSL for the area around Rotenburg (Wümme) Airfield.

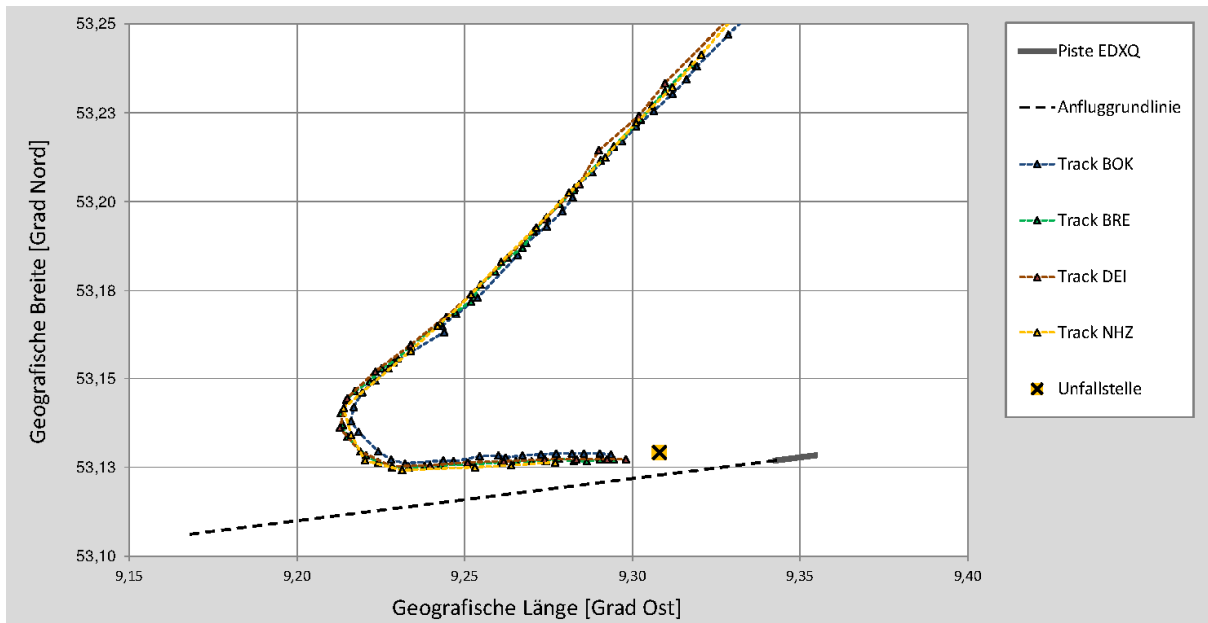


ICAO Aeronautical Chart 1:500 000, edition March 2013

Source: DFS

The highest point around Rotenburg (Wümme) Airfield published in the visual operation chart of the Aeronautical Information Publication VFR (AIP-VFR) was 300 ft AMSL.

The BFU had available the flight path recordings of the Bundeswehr (German Armed Forces) and of three radar stations of the German air traffic service provider.



Flight path during the final approach according to radar data

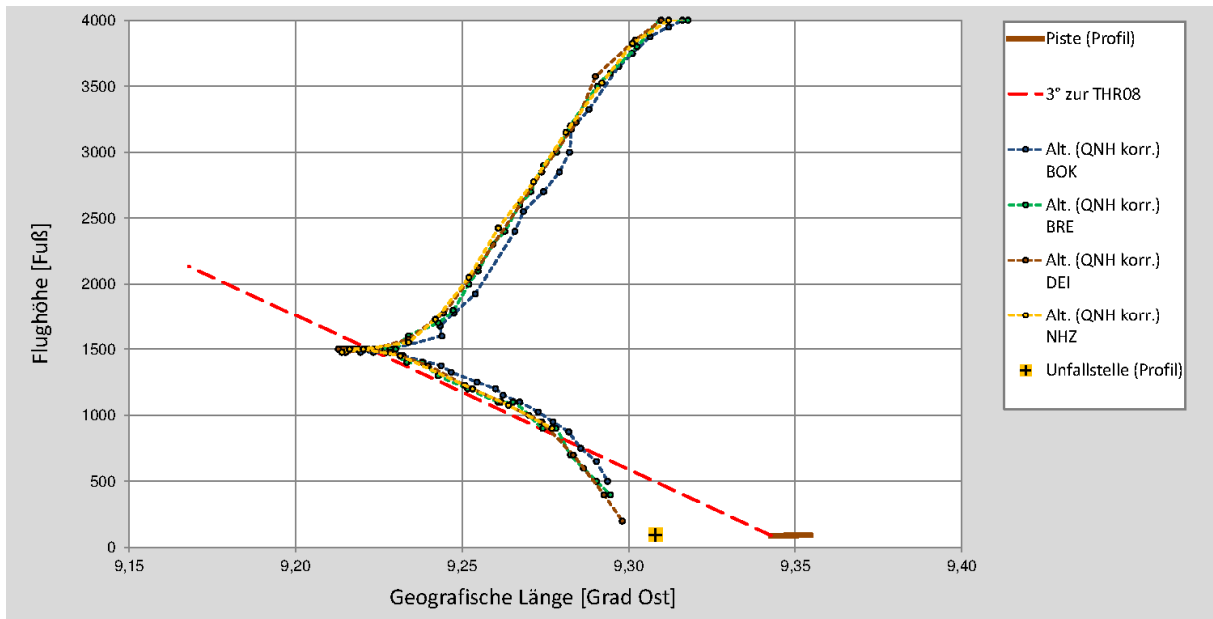
Graph: BFU

The assessment of the radar recording shows that after the left-hand turn the airplane maintained a course over ground of about 90°.

Approximately 4.5 NM ahead of the threshold of runway 08 and a lateral deviation of about 1,400 m left of the extended runway centre line the descent began with a landing course of 90°.

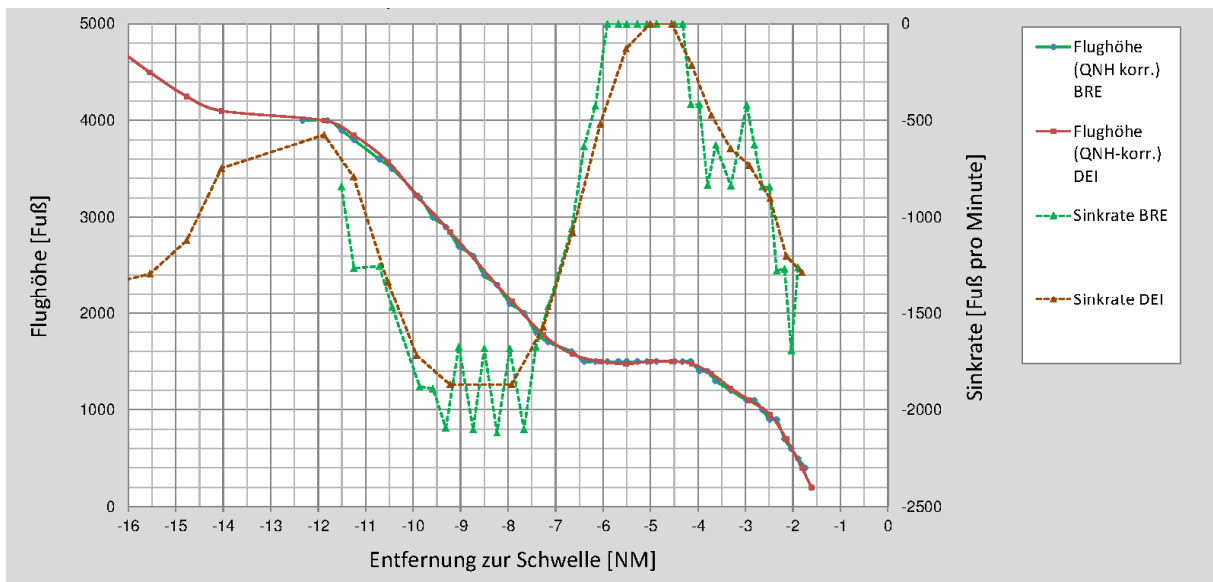
The glideslope was about 3° over a distance of approximately 1.5 NM and until about 800 ft AMSL.

Below 800 ft and at approximately 2.5 NM ahead of the threshold the rate of descent increased. The rate of descent had a maximum of about 1,400 ft/min and was therefore more than twice as high as during the 3° approach.



According to radar data, altitude of the airplane during final approach

Graph: BFU



According to radar data, altitude and rate of descent

Graph: BFU

Radio Communications

Radio transmissions between the airplane and Bremen Radar were recorded between 0849:34 hrs and 0912:15 hrs. As described in “History of the Flight”, the recordings contained relevant information regarding the course of the flight and the decisions made in the cockpit.

Radio transmissions on the frequency of Rotenburg (Wümme) Airfield were not recorded.

Aerodrome Information and Airspace Structure

Rotenburg (Wümme) Airfield is located approximately 2.2 NM north-west of the city of Rotenburg (Wümme). Airport elevation is 97 ft AMSL. It has two runways oriented 077°/257° (08/26). The grass strip is 750 m long and 40 m wide; the asphalt runway is 806 m long and 30 wide.

The airfield is certified for VFR flights with aircraft up to a maximum take-off mass of 5,700 kg.

The asphalt runway is equipped with threshold, edge, and end lighting.

At the time of the accident runway 08 with a Landing Distance Available (LDA) of 806 m was in service and the runway lighting switched on.

The airfield is not equipped with equipment to measure cloud bases and visibilities.

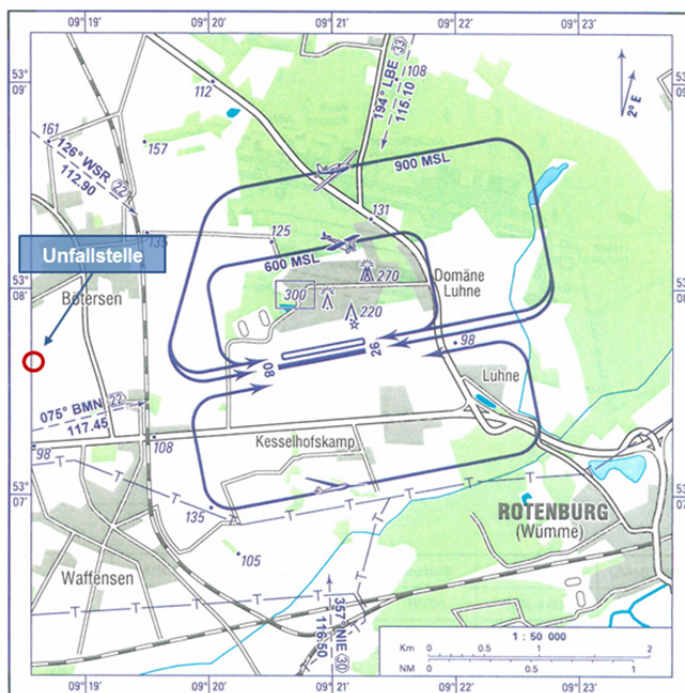
Due to the airspace classification, for a VFR approach to Rotenburg (Wümme) Airfield visibilities must be at least 8 km above 2,500 ft GND and the aircraft has to maintain a distance to the clouds of at least 1.5 km lateral and 1,000 ft vertical. Below 2,500 ft visibility shall not be less than 1.5 km. The pilot has to ensure that ground in sight is always given and the aircraft remains free of clouds.

Flight Recorder

The airplane was not equipped with a Flight Data Recorder (FDR) or a Cockpit Voice Recorder (CVR). There were no legal requirements for such equipment to be fitted.

Wreckage and Impact Information

The accident site was located 1.24 NM ahead of the threshold of runway 08 of Rotenburg (Wümme) Airfield and approximately 570 m north of the extended runway centre line in about 100 ft AMSL on a plane, agricultural piece of land free of obstacles.



Excerpt visual operation chart (as of 08/2011) and accident site
 Source: DFS, adapted by BFU

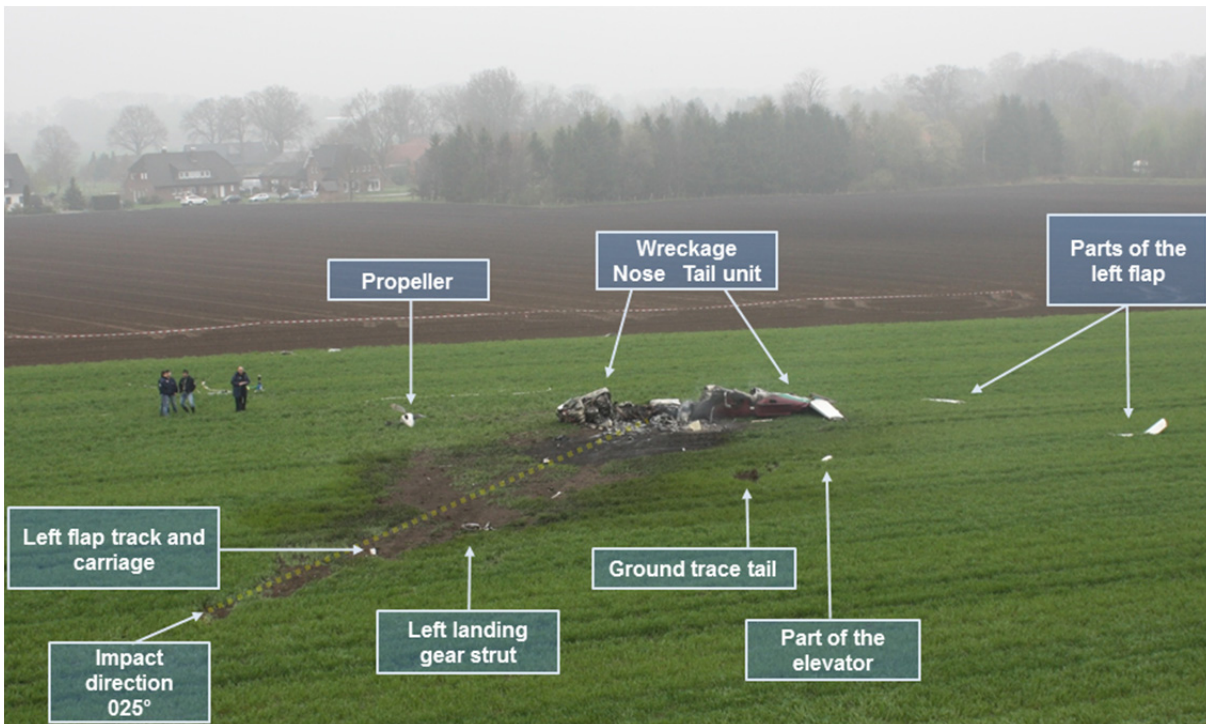
The traces on the ground, a few centimetres deep, ran a distance of 34 m in the direction 025°. It was possible to match the first ground trace with the left wing. The subsequent traces on the ground could be matched with the entire left wing and the left main landing gear. The last extensive ground trace right in front of the wreckage could be matched with the fuselage.

In its final position, the nose of the wreckage pointed toward 300°.

Along the impact line several airplane parts were found in the direction of the wreckage: Fracture pieces of the composite fairing of the outer flap track, parts of the flaps, a landing gear support beam, and other landing gear parts.

The propeller was found 12 m from the engine in the extended airplane longitudinal axis. Parts of the left flap were found behind the wreckage.

At the accident site all components could be identified.



Accident site

Source: Police, adapted by BFU

The cabin area had burnt out completely. The entire tail section had been torn out of position by 180° and was lying on its back.

The left wing including the aileron had almost completely burnt. Parts of the left flap had separated from the wing. The right wing including aileron and flap had been severely damaged by fire.

The left landing gear strut had been torn off. The nose landing gear and the right main landing gear were bent, but still connected with the wreckage.

The propeller had been torn off at the flange. All four blades were bent.

The actuating cylinder of the nose landing gear was extended.

Based on an impact mark on the flap track and carriage it was possible to determine that the flap of the right wing had been extended by about 20%.

Under supervision of the BFU a representative of the engine manufacturer examined the engine by borescope inspection. The examination results were:

"With reference to the on-site and borescope inspection of the compressor and power turbine please find hereafter: Based on the information available, PT6A-64

series engine, ESN PM0069, was rotating under power at impact. Evidence of debris inside the compressor, accumulation of dirt on the inlet screen, rubbing of PT blade tips, fractured propeller shaft and "S"-shape bending on one of the blades all indicate the subject engine was running under power at impact. The actual propeller torque value at impact could not be determined based on the pictures."

Due to the high degree of destruction, especially by fire, it was not possible to determine the indications of instruments, except for the QNH selection at one altimeter. This was also true for the positions of levers and selectors in the cockpit.



QNH selection at the altimeter about 1,010 hPa

Source: BFU

Medical and Pathological Information

The post-mortem examination of the person in the left-hand seat revealed that cause of death was burning. There was no blood alcohol present, and no evidence of drug intake, which would have affected the psyche.

The post-mortem of the person in the right-hand seat revealed burning, inhalation of smoke, and multiple trauma as cause of death. There was no blood alcohol present, and no evidence of drug intake, which would have affected the psyche.

Fire

The airplane caught fire after the impact.

A total of 12 fire brigade vehicles and 48 fire fighters were deployed to fight the fire.

Additional Information

The Flight Manual Chapter 4 described the go-around procedure for the TBM 700:

- *Power lever: TRQ 100%*
- *Attitude: 7,5° (The airplane will tend to yaw to the left when power is applied. Right rudder pressure will be required to maintain coordinated straight flight until the rudder trim can be adjusted.)*
- *Flaps: T/O (If speed has been maintained at 80 KIAS or more and TRQ 100%, select T/O flaps as soon as the 8° attitude has been attained.)*

If the vertical speed is positive and if IAS is at or above 85 KIAS:

- *Landing gear control: UP*

Analysis

Accident / General

The aircraft collided with the ground during a VFR approach.

The ground traces at the accident site showed that prior to the impact the airplane had turned left from the landing course by about 55°, and, with a left bank angle, had ground contact with the left wing. The BFU is of the opinion that this movement around the longitudinal and lateral axes is the result of the propeller torque while the engine torque was set in order to avoid the collision with the ground.

As a result of the ground contact the airplane turned left around its longitudinal axis by about 85°. During the resulting lateral movement the airplane impacted the ground.

Neither the recorded radio transmissions, nor the findings at the accident site, nor the statements of the witnesses, indicated any technical problem, which could have contributed to the accident.

The witness statements, the weather data, and the expert meteorological assessment show that in the area of the accident site low clouds, mist, fog with slight drizzle prevailed.

The approach to the airfield correlates in several points with a Controlled Flight Into Terrain (CFIT) and the trace pattern at the accident site allows the conclusion that a loss of control occurred during a go-around procedure.

Pre-flight Preparation

The statements of the waiting passengers and of the Flugleiter show congruently that both pilots had been aware of the marginal weather conditions at Rotenburg (Wümme).

The flight plan listed Bremen Airport as alternate aerodrome, but was never mentioned in the phone calls with the waiting passengers prior to the flight.

The assessment of the access data revealed that at the day of the accident prior to take-off no flight planning data including weather information was accessed via the DWD. No Meteorological Briefing Centre had performed an individual weather briefing for this flight.

There was no evidence that one of the pilots had accessed weather data through any information source at the aerodrome of departure.

The assessment of the weather data of the aerodrome of destination – Overcast 500 ft GND – showed that at the airfield Airspace G conditions prevailed. The pilots were aware of these weather conditions when they conducted the change of flight rules from IFR to VFR - approximately 5 NM north at 4,000 ft AMSL - and should have known that during the approach they would still be in IMC.

Conduct of the Flight

The radio transmission recordings the BFU had available show that between 0912:03 hrs - approximately 4 minutes prior to the accident - with the request for clearance to switch to VFR "*[...] cancelling IFR now*" the decision had been made to change the flight rules and land in Rotenburg (Wümme).

The recordings also show that the pilots never asked the controller about the weather conditions in Rotenburg (Wümme) or Bremen. Based on the radio recordings it could not be determined whether an approach to Bremen was ever considered an option

during the flight. There was no information available whether the pilots listened to the ATIS reports of Bremen Airport or Hamburg Airport.

The pilot in the right-hand seat had established radio contact with Rotenburg (Wümme) Airfield. Thus they had all data about the weather conditions at the airfield available to them; these were no different than the ones they had received prior to departure.

It is highly likely that the approach to land was conducted manually. The BFU is of the opinion that below 800 ft the pilot flying had consciously chosen a high rate of descent. It was intended to get below the clouds, at the airfield their base was at 500 ft GND, gain ground in sight and reach the airfield.

The findings at the airplane and the ground traces reveal that the pilot flying wanted to go-around, but the procedure failed. The setting of the engine torque occurred without the subsequent rudder deflections for a coordinated straight and level flight. Subsequently, yaw and roll movements occurred which resulted in the left wing colliding with the terrain. The BFU is of the opinion that this erroneous control input was due to the pilots having ground in sight only in the immediate vicinity of the terrain and were surprised by the sudden need for a go-around procedure.

Specific Conditions

After the change of flight rules had occurred the approach was conducted in instrument meteorological conditions.

At the time of the accident, at Rotenburg (Wümme) Airfield weather conditions, which met the weather minima for Airspace G, prevailed. But the drizzle moving in from the west - as observed at the accident site - worsened the conditions in the approach area.

The alternate aerodrome, Bremen Airport, could be approached under IFR.

Both pilots had together acquired the TBM 700 rating and had almost the same flying experience on type. Prior to the accident they had conducted 68 flights with each other. The pilot in the right-hand seat was familiar with Rotenburg (Wümme) Airfield, the one in the left-hand seat not.

The BFU is of the opinion that prior to and during the flight, the two pilots had either come to their decisions together or accepted the decision of the other without contradiction. This was intensified by the outside pressure, because of the two

waiting passengers at the aerodrome of destination and the slot waiting for them at Friedrichshafen Airport, which had to be met.

The BFU was not able to determine which one of the two pilots was the pilot flying at the time of the accident.

Even though GPS systems were on board the approach was not aborted. They did not pay any attention to the vertical flight path.

Conclusions

The accident was due to the following:

The pilots had decided to conduct an VFR approach, even though the weather conditions were insufficient. Therefore, the close proximity to the terrain could not be recognised in time.

Due to insufficient situational awareness of the pilots the descent was not aborted in time.

Investigator in charge:	Jens Eisenreich
Field investigation:	Axel Rokohl, Thomas Kostrzewa, Uwe Berndt
Avionics analysis:	Philipp Lampert
Flight path analysis:	Klaus Himmler

Braunschweig, 31 May 2017

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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