Bundesstelle für
Flugunfalluntersuchung

German Federal Bureau of
Aircraft Accident Investigation

Investigation Report

Identification

Type of Occurrence:	Accident
Date:	31 March 2019
Location:	Near Frankfurt-Egelsbach
Aircraft:	Airplane
Manufacturer:	Experimental amateur built
Type:	Epic LT
Injuries to persons:	Pilot and two passenger fatally injured
Damage:	Aircraft destroyed
Other Damage:	Crop damage
State File Number:	BFU19-0272-CX

Abstract

During a turn in low altitude, the airplane entered an uncontrolled flight attitude, impacted the ground, and burned.

Factual Information

History of the Flight

At 1357 hrs[1], the airplane had taken off from Cannes-Mandelieu Airport, France, to a private flight to Frankfurt-Egelsbach Airfield, Germany. On board were the pilot and two passengers. The co-owner of a Russian airline (the operator of the Epic LT was one of its subsidiaries) and her father, who were expected at Frankfurt-Egelsbach Airfield because they had an appointment at Frankfurt/Main, were the passengers on board. Initially, the flight was conducted under instrument flight rules and then changed to visual flight rules. According to the flight plan, cruise flight was planned for Flight Level (FL) 260.

At 1519:03 hrs, the pilot established contact with Langen Radar, and informed the controller that the airplane was in descent to FL60 towards reporting point UBENO. The radar recordings show that the airplane was flying towards 335° and transmitted the transponder code 4065. The radar controller issued the descent clearance to 4,000 ft AMSL and conveyed a QNH of 1,020 hPa.

At 1519:25 hrs, the controller addressed the pilot: “[…] proceed direct DELTA, runway zero eight in use.” The pilot acknowledged the clearance. At 1520:20 hrs, the controller instructed the pilot to descend to 3,500 ft AMSL.

After the pilot had acknowledged the controller’s request, the change of flight rules from IFR to VFR was conducted at 1521 hrs about 16 NM south of Egelsbach Airfield. At the time, the airplane was at about 5,000 ft AMSL with a ground speed of approximately 240 kt. At 1521:50 hrs, the radar controller said: “[…] continue descent to stay clear of airspace Charlie, switch over Egelsbach one one eight four zero five.” Ten seconds later, shortly after the pilot had acknowledged the instruction, the descending airplane reached the border of airspace C at 4,100 ft AMSL, which begins at 3,500 ft AMSL (Appendix 1).

At 1522:34 hrs, the airplane was at 3,500 ft AMSL and about 14 NM from the airfield, the pilot established radio contact with Frankfurt-Egelsbach Information with the words: “[…] inbound DELTA, descending VFR.” The Flugleiter (A person required by German regulation at uncontrolled aerodromes to provide aerodrome information service to pilots) answered: “Hello […] runway zero eight, QNH one zero two zero, squawk four four four one.” The pilot acknowledged the landing direction and the

1 All times local, unless otherwise stated.

QNH. The communicated transponder code was not acknowledged and did not change during the remainder of the flight, according to the radar recording.

According to the radio recording, immediately after he had finished his radio communication with the Epic's pilot, the Flugleiter radioed the crew of a Piper PA-28 south of Darmstadt, also approaching Frankfurt-Egelsbach Airfield. He advised them of the "very fast" approaching Epic coming from the south and asked the PA-28 crew to slow down their approach in order to approach after the other aircraft. The Flugleiter then described the position and the indicated altitude of the Epic. Due to communications problems on board of the PA-28, the Flugleiter repeated himself, so that this radio message lasted about 45 s. At 1523:51 hrs, the Flugleiter informed the PA-28 crew that the Epic had passed them at 2,500 ft and they "could turn back to Delta".

He had deliberately refrained from calling the Epic pilot asking him to change the transponder code in order to not put him under additional stress during the second approach.

At 1523:57 hrs, the Epic entered airspace C (starting at 1,500 ft AMSL, Appendix 1) at about 2,500 ft AMSL. The Flugleiter stated that at 1524.34 hrs, he had given them the information: "[…] the maximum altitude in this area is one thousand five hundred feet". The pilot answered: "Roger, continue descent […] ". At the time, altitude was about 2,000 ft AMSL.

According to the radar recording, at 1524:52 hrs the airplane reached position DELTA and turned right in northern direction toward the approach path to runway 08 of Frankfurt-Egelsbach Airfield. Altitude was about 1,900 ft AMSL and ground speed 170 kt. At 1525:57 hrs, as the aircraft reached the southern border of the Aerodrome Traffic Zone (ATZ) it had descended to about 1,300 ft AMSL.

At 1526:30 hrs, at approximately the Tank- und Rastanlage Gräfenhausen (resting facility) at the Bundesautobahn A5 (motorway), the aircraft began to turn right up to a north-eastern direction. At the time, the aircraft was at 1,300 ft AMSL with a ground speed of about 140 kt.

At 1526:44 hrs, the Flugleiter addressed the pilot: “[…] do you have the field in sight?” The pilot responded: “Ah, not yet […].” At the time, the airplane was about 1,000 m south-west of threshold 08 at the western outskirts of Erzhausen flying a north-eastern heading. According to the radar data, ground speed was about 125 kt at about 1,300 ft AMSL. The Flugleiter added: “I suggest to reduce, you are now on right base.” After the pilot had answered with “Roger”, the Flugleiter added: “You are number one to land. The wind is zero four zero, one zero knots.” Then the airplane started to descend.

At 1527:04 hrs, as the airplane was about 300 m south of threshold 08 flying a north-eastern heading, the radio message “[unintelligible] approach“, was recorded. From then on the airplane began to turn left.

At 1527:11 hrs, the airplane crossed runway 08 with a ground speed of about 100 kt at very low altitude with a northern heading.

At 1527:24 hrs the pilot said: “[…] may I the […] make an orbit?” The Flugleiter answered: “Yes, do it to your left-hand side and do not overfly the highway westbound.”

At 1527:31 hrs, the last radar target was recorded at approximately 600 m north-west of threshold 08. About 100 m south-west of it, the airplane crashed to the ground and caught fire. All three occupants suffered fatal injuries.

At the time of the accident, three persons were in the Tower of the airfield: the Flugleiter, as tower controller, his replacement, and the apron controller. They observed that the airplane flew directly towards the tower coming from the DELTA approach in descent with north-eastern heading, i.e. diagonal to the landing direction. In this phase the landing gear extended.

Two witnesses, who were at the airfield close to the tower, stated that they had seen the airplane during the left-hand turn. They estimated the bank angle during the turn was 30-45°.

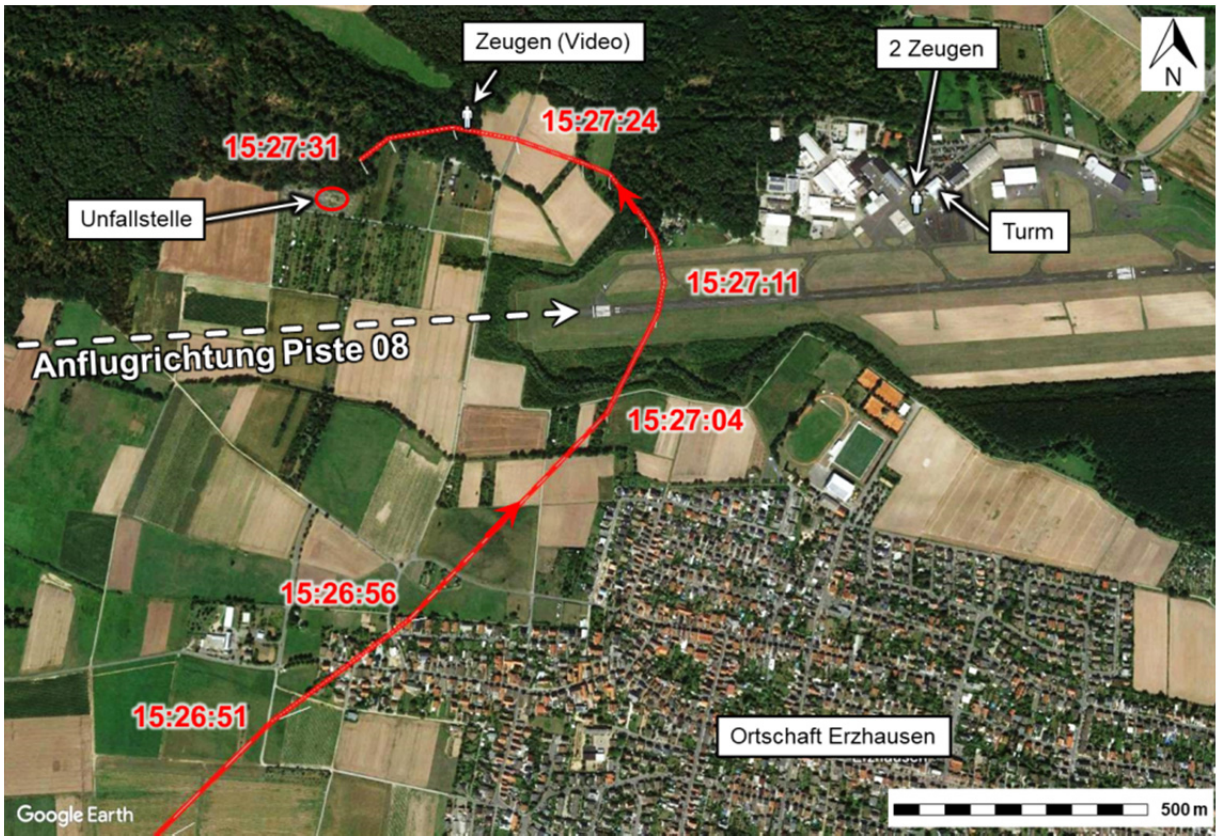

Fig. 1: Flight path according to radar data and location of witnesses Source: GoogleEarth™, adaptation BFU

The two occupants of a Piper PA-28, which had been on approach to runway 08, stated that they had become aware of the other airplane, before changing from downwind leg to final approach. They also stated that during the turn the airplane went into a dive and impacted the ground after about a half turn.

Approximately 330 m north-east of the accident site, persons had been walking in a forest. One of them recorded a video. This recording was made available for investigation purposes. The video shows the shadow of the airplane moving west immediately prior to the accident. Consistent engine sounds and, eight seconds after the shadow passed, the crash of the airplane can be heard.

Personnel Information

The 53-year-old pilot held an Airline Transport Pilot License (ATPL(A)) last issued on 12 April 2017 by the Russian civil aviation authority. His licence listed the ratings for Boeing 737CL and 737NG, Gulfstream G550 and for single engine land. In addition,

the instructor rating for single engine and the English Language Proficiency Level 4, valid until 24 March 2020, were listed.

His class 1 medical certificate was issued on 12 February 2019 and valid until 12 February 2020.

The operator of the Epic LT stated that the pilot had a total flying experience of about 11,425 hours; of which approximately 7,687 hours as Pilot in Command (PIC). He had flown about 676 hours as PIC on the Epic LT. In the last 24 hours prior to the accident he had flown the airplane for 2:38 hours; in the last 90 days he had flown about 86 hours of which about 81 hours on type.

The statement of the operator reveals that 28 March 2019 was the pilot's last day off. On 29 March 2019 he had worked six hours in the office. On the day prior to the accident, 30 March 2019, he had begun pre-flight preparations at Moscow-Domodedovo Airport, Russia, at 0650 UTC for the flight to Krakow, Poland, and had taken off at 0752 UTC. After 02:53 hours, the airplane landed at Krakow Airport. At 1132 UTC, after refuel, the airplane took off for Cannes Airport, France, where it landed at 1405 UTC (1505 hrs). On the day of the accident, the pilot arrived at Cannes Airport at 1230 hrs for pre-flight preparations for the flight to Frankfurt-Egelsbach. At 1345 hrs, the two passengers arrived at the airport.

Aircraft Information

The Epic LT is a construction kit for a single engine, low-wing, mostly carbon fibre reinforced composite aircraft seating six. It is equipped with a pressurized cabin and a retractable landing gear in nose wheel configuration. The manufacturer stated that the Epic LT fleet consisted of several dozen airplanes. Eight months after this accident, the US American Federal Aviation Administration (FFA) certified the type Epic E1000 which is based on this airplane.

The aircraft has a wing span of 13.12 m, a fuselage length of 10.92 m and a height of 3.81 m.

Kit Manufacturer:	Epic Aircraft
Manufacturer's Serial Number (MSN):	019
Year of Manufacture:	2008
MTOM:	3,402 kg

Dry Operating Mass:	2,194 kg
Total Operating Time:	2,221:46 hours and 1,317 cycles
Engine:	Pratt & Whitney Canada PT6A-67A with 1,200 shp power
Propeller:	Hartzell HC-E4A-3D

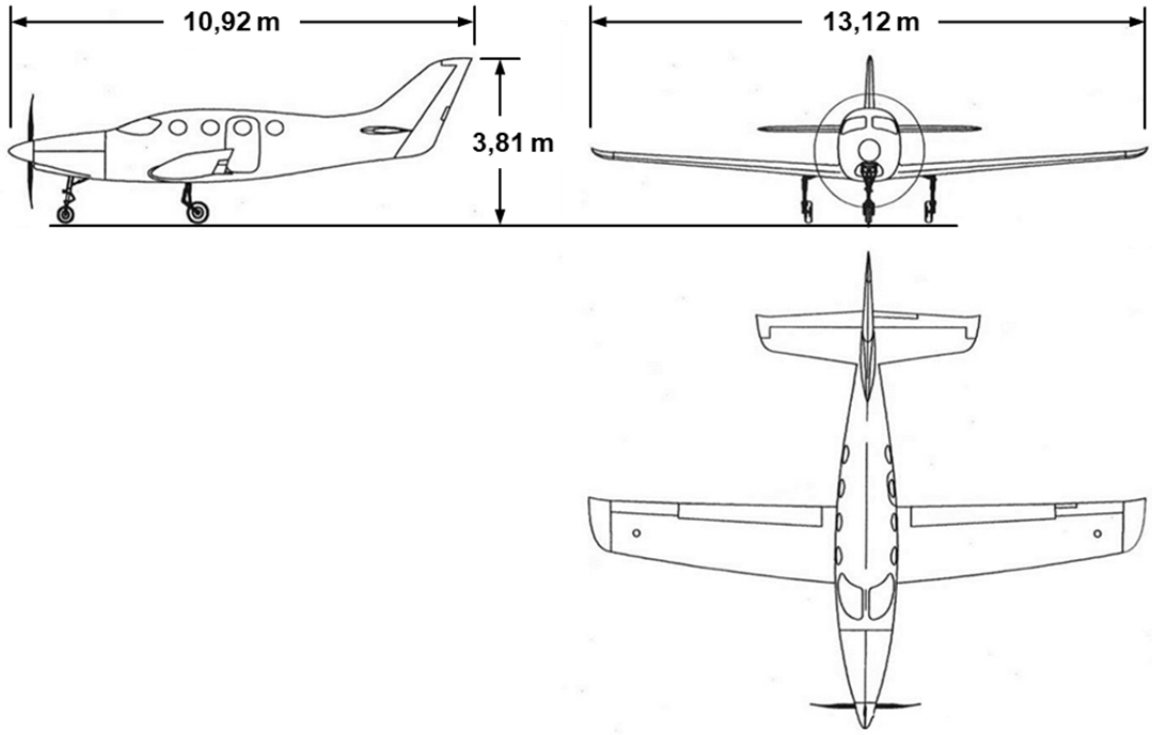

Fig. 2: Three-way view Epic LT Source: FAA, adaptation BFU

In September 2008, the Amateur-Built Aircraft (category Experimental) was certified in the USA in accordance with Title 14 CFR 21.191 (g).

After the airplane was exported to Russia, on 4 December 2014 the civil aviation authority of the Russian Federation had issued a certificate of registration as Single General Aviation Aircraft (Единичный экземпляр воздушного судна (*ЕЭВС*)). On 11 December 2018, the last airworthiness certificate was issued by the West-Siberian department of the civil aviation authority of the Russian Federation and valid until 11 December 2019. According to the airworthiness certificate, the airplane was certified for VFR day and night flight as well as for IFR (60 m (200 ft) cloud base, visibility 800 m).

On 12 February 2019, the Luftfahrt-Bundesamt (German civil aviation authority) had issued Permission for foreign aircraft with restricted certification valid until 11 December 2019.

On 21 March 2019, the last 300-h engine maintenance had been performed at a total operating time of about 2,214 hours and 1,314 cycles.

The airplane was equipped with a Garmin G900X avionic system. It is an integrated system that indicates flight parameters as well as data to position, navigation, communication, and identification. It has three large displays: the Primary Flight Displays (PFD) one each on the left and right side, and the Multi-Function Display (MFD) in the middle of the panel. There are also different Line Replaceable Units (LRU) which provide data for the displays. The displays are fitted with SD slots for data storage mediums containing navigation data or as storage for a multitude of technical parameters.

The airplane was equipped with a TruTrak Sorcerer AS autopilot.

Flight Manual

The operator of the airplane provided the EPIC LT airplane flight manual which contained speed information for the respective configurations, among other things:

The maximum speed with flaps in position 14° was 180 KIAS; for position 40° 130 KIAS.

Maximum speed for the extension of the landing gear was 170 KIAS.

Minimum speed with retracted flaps was 115 KIAS.

Stall speeds for the different flap positions were as follows:

$V_{S0°}$ 80 KIAS

$V_{S14°}$ 75 KIAS

$V_{S40°}$ 67 KIAS

The BFU has no information as to the amount of fuel on board during departure in Cannes. According to the flight manual, the aircraft had a payload of 331 kg if the tanks were full (877 kg). According to the post-mortem report, the three occupants had a total mass of about 235 kg. According to the operator, no heavy luggage was on board during the accident flight. Therefore, take-off mass was about 3,071 kg.

Meteorological Information

At the time and place of the accident, visual meteorological conditions prevailed.

According to the aviation routine weather report (METAR) of 1520 hrs at Frankfurt/Main Airport, located about 5 NM north-west of Frankfurt-Egelsbach Airfield, the following weather conditions were recorded:

Wind:	020°/6 kt, wind direction variable between 340° and 060°
Visibility:	More than 10 km
Cloud:	3-4 oktas Towering Cumulus (TCU)
Temperature:	18°C
Dewpoint:	4°C
QNH:	1,020 hPa

According to the Flugleiter of Frankfurt-Egelsbach Airfield, at the time of the accident wind velocity was 040° and 10 kt.

At the time of the accident, the sun was in 218° at about 38° above the horizon.

Aids to Navigation

The Aeronautical Information Publication (AIP) stipulated the following for approaches to and departures from the airfield of aircraft with jet or turboprop engines, among other things:

> *3.1 Approaches with jet aircraft and turboprops are only permitted subject to the following provisions:*
>
> *a) For runway 08:*
>
> *Entry via DELTA along the A5 motorway onto right base of runway 08.*
>
> *b) For runway 26:*
>
> *Entry via YANKEE directly onto final approach.*
>
> *[…]*

3.6 After establishing visual contact with the APAPI, it is recommended to begin the final approach at a minimum altitude of 1300 ft MSL and an approach angle of 4.4°.

[…]

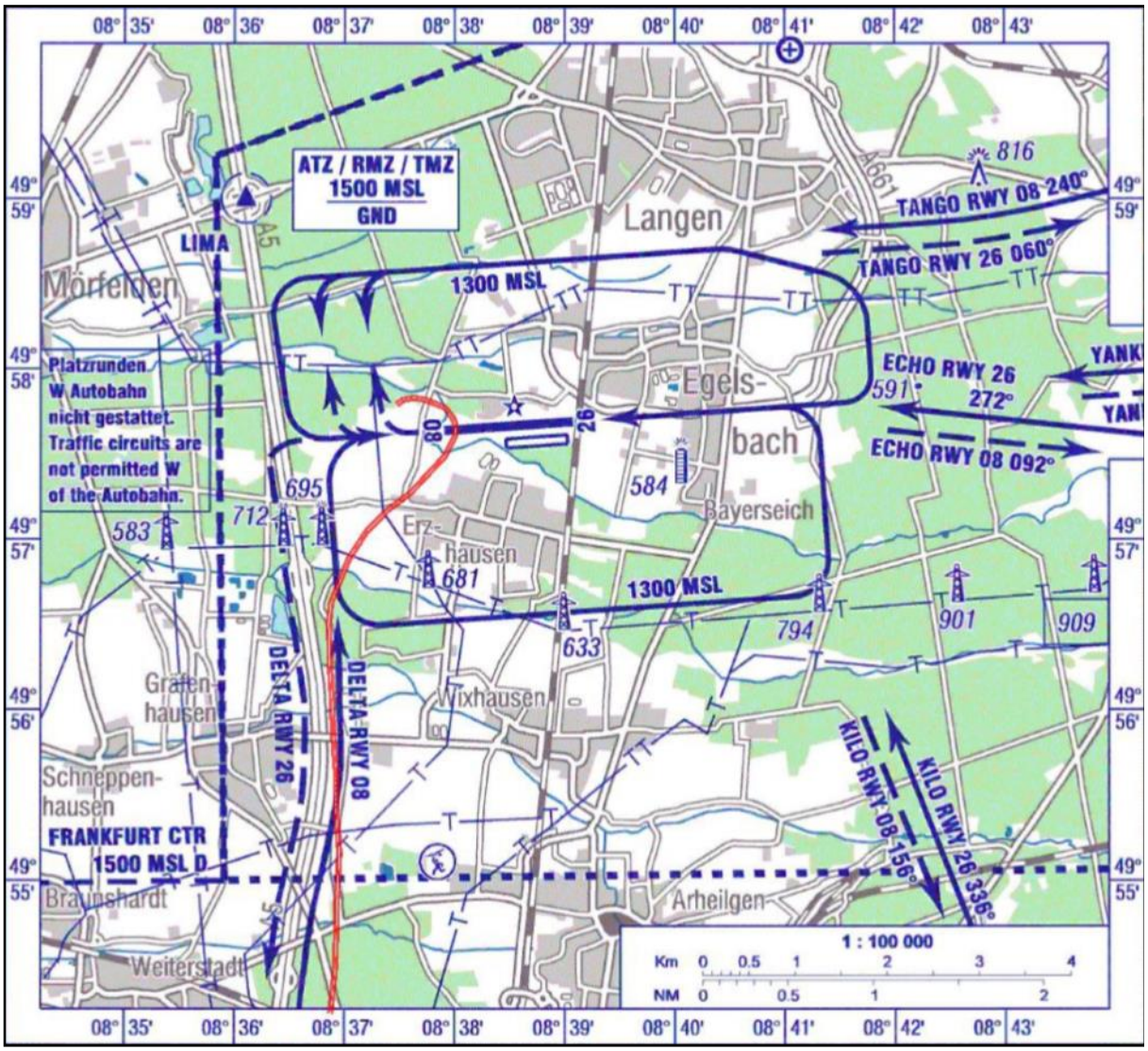

Fig. 3: Excerpt of the visual approach chart of Frankfurt-Egelsbach Airfield with flight path of the aircraft (red line).
Source: AIP, adaptation BFU

Radio Communications

The Epic LT pilot was in radio contact in English with Frankfurt Radar as well as with Frankfurt-Egelsbach Information. Radio communications between Frankfurt-Egelsbach Information and the PA-28 crew were conducted in German.

The BFU was provided with the voice recordings between 1519 hrs and the time of the accident for investigation purposes.

Aerodrome Information

Frankfurt-Egelsbach Airfield is located 0.27 NM south-west of Egelsbach in the Rhine-Main Region south-east of Frankfurt/Main Airport in the triangle of the cities Frankfurt/Main, Offenbach and Darmstadt. Aerodrome elevation is 385 ft AMSL.

The airfield had two parallel runways with the orientations 084° and 264°. The asphalt runway was 1,400 m long and 25 m wide. The grass strip had a length of 670 m.

In general, two persons are on duty as Flugleiter/Aviation Supervision. The airfield had two frequencies: Egelsbach INFO and Egelsbach APRON.

The Tower workstation was equipped with a radar monitor.

According to the AIP, it was stipulated that the Flugleiter (Egelsbach INFO) shall issue flexible transponder codes to all approaching aircraft. The Codes A4440-A4443 were intended for this purpose.

Airspace Structure

Frankfurt-Egelsbach Airfield was surrounded by an ATZ including Radio Mandatory Zone (RMZ) and a Transponder Mandatory Zone (TMZ), which extended from the ground up to 1,500 ft AMSL. In the west and the north the ATZ bordered the control zone and above the ATZ the Airspace C of Frankfurt/Main Airport.

Two traffic patterns existed north and south of the runway. Traffic pattern altitude was 1,300 ft AMSL.

The distance between threshold runway 08 and the Autobahn A5 (base leg runway 08) was 1,765 m.

Flight Recorder

The aircraft was not equipped with a cockpit voice recorder or flight data recorder. These recording devices were not mandatory.

The air navigation service provider provided the BFU with the recorded radar data of individual radar stations. The data of the stations GOT, PAF and FFS were analysed more closely. Depending on the location of the station in relation to Frankfurt-Egelsbach Airfield, the position data was laterally slightly displaced but showed vertically and in time response a similar flight path. The data of the last flight phase was analysed in regard to the runway threshold 08 and depicted as top-view graph (Fig. 4 above) as distance in Meter. The vertical view shows relative altitude above runway 08 (Above Aerodrome Level - AAL) over the distance to the runway threshold (Fig. 4 below).

The calculated data revealed that initially the airplane flew north-east toward Frankfurt-Egelsbach Airfield. Altitude and ground speed decreased continuously. During the left-hand turn, altitude decreased further to about 230 ft AAL. Ground speed decreased to approximately 94 kt. The calculated curve radius was below 500 m. Towards the end of the radar recording, ground speed and vertical speed increased again slightly.

As illustration and comparison with the published standard approach procedures at Frankfurt-Egelsbach Airfield, the vertical speed of the airplane, calculated from the radar points, a 3° approach angle and the APAPI approach angle of 4°24“ (4,4°) were included (Fig. 4 below) in the depiction of the vertical flight path.

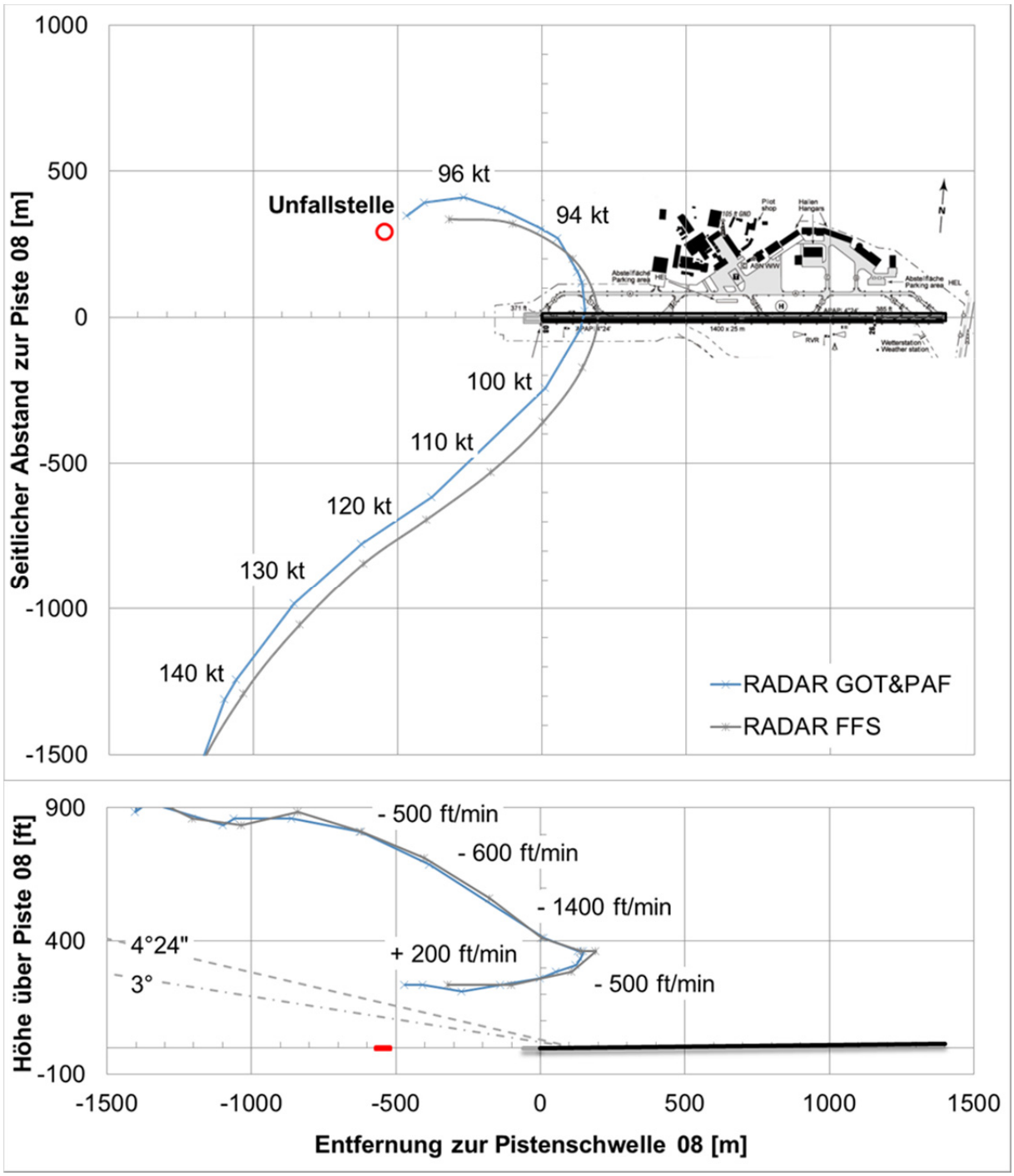

Fig. 4: Flight path lateral and vertical with data of two radar stations in relation to runway 08 Source: BFU

Wreckage and Impact Information

The accident site was located about 600 m north-west of threshold 08 and about 300 m north of the extended runway centre line, at a flat asparagus patch, which was partially covered with plastic.

The plastic had either burnt or melted in an almost circular area with a radius of about 20 m around the wreckage.

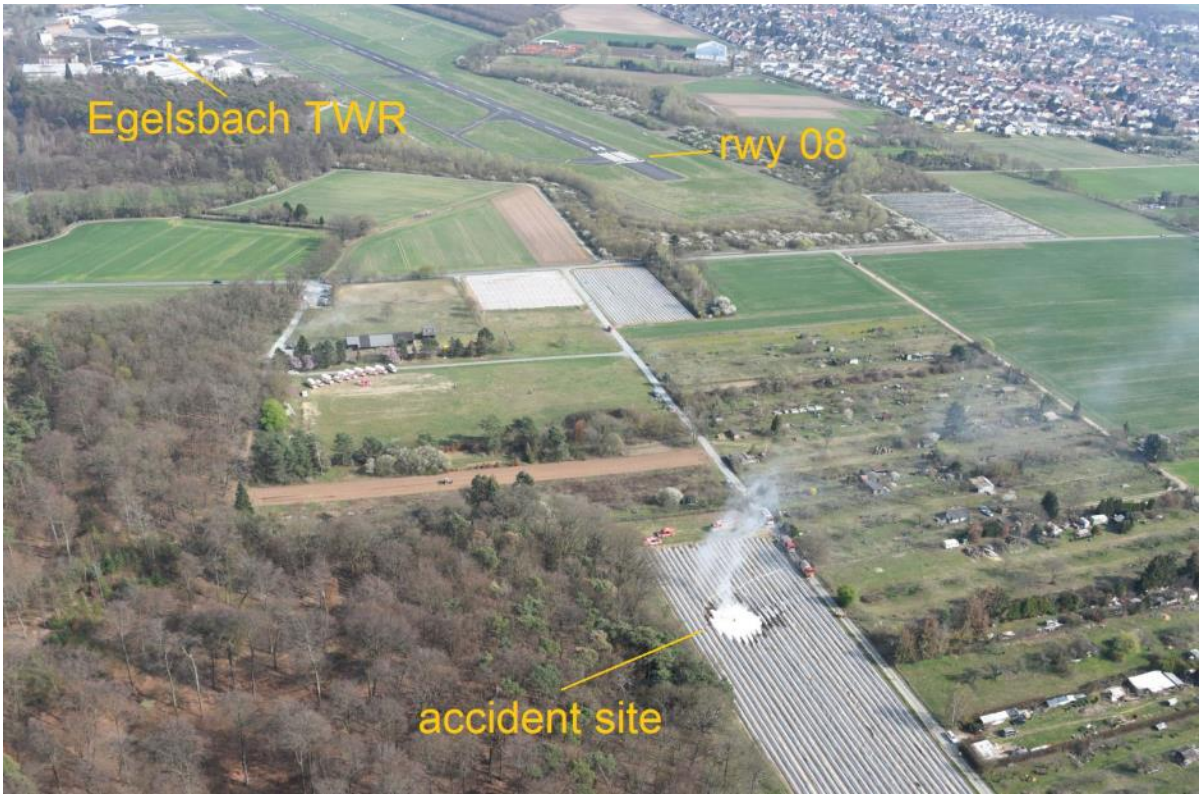

Fig. 5: Location of the accident site in relation to the airfield; viewed to south-east

Source: Police, adaptation BFU

The traces at the accident site and the damage on the aircraft showed that the airplane had impacted the ground with an almost vertical flight path with nose down attitude and slight left bank angle. The fuselage nose including the spinner of the propeller pointed toward approximately 020°.

The entire fuselage and wing unit had been destroyed by fire. The aft part of the fuselage, between wing trailing edges and the empennage, was intact, but the structure had been destroyed by fire. The front part of the fuselage including cockpit had

been destroyed by fire except for the floor component. The cockpit displays (PFD and MFD) including SD-cards had been destroyed by fire.

The wings had separated from the fuselage and were lying on the ground turned left about the vertical axis by about 25°. On the right wing the flap was folded beneath the aft wing spar. The weather radar had been torn off the right wing and was lying about 5 m north of the wreckage. The landing gear was extended.

Fig. 6: Overview of the wreckage, viewed toward west Source: BFU

Due to the high degree of destruction, technical examination of the wreckage was possible only to a limited extent.

Fig. 7: Damage on the propeller blades and the spinner Source: BFU

Two of the four propellers blades were deformed contrary to their rotating direction. The examination of the engine with a Boroscope showed ingested earth and soot in the area of the first stage compressor rotor.

Medical and Pathological Information

The Institut für Rechtsmedizin des Universitätsklinikums Frankfurt/Main performed the post-mortem examination of the three bodies of the occupants. Cause of death of all three was multiple trauma.

The chemical-toxicological examination of body fluids and tissue samples of the pilot showed only caffeine.

Fire

The airplane caught fire on impact. The police mission record showed that at 1527 hrs the police had received the first call reporting the accident and the fire. One minute later fire brigade and rescue personnel were requested. At 1530:10 hrs, rescue personnel were on site. A police helicopter took aerial photos which document that at 1537 hrs fire-fighting operations were under way.

Organisational and Management Information

The operator was a company which had a permit of the Russian Ministry of Transport valid until 4 March 2020 for the conduct of general aviation flights. The company was a subsidiary of a Russian airline.

The company employed 5 pilots for the operation of the Epic LT; the pilot of the accident flight was one of them.

The company had compiled the following documents in Russian for the Epic LT:

- *РУКОВОДСТВО ПО ПРОИЗВОДСТВУ ПОЛЕТОВ АВИАЦИИ ОБЩЕГО НАЗНАЧЕНИЯ (General Aviation Flight Operation Manual)*
- *РУКОВОДСТВО ПО ЛЕТНОЙ ЭКСПЛУАТАЦИИ ВОЗДУШНОГО СУДНА Epic LT (Epic LT Airplane Flight Manual)*
- *ТЕХНОЛОГИЯ РАБОТЫ ЭКИПАЖА ВОЗДУШНОГО СУДНА Epic LT (Epic LT Standard Operating Procedures)*

The *General Aviation Flight Operation Manual GH.GA.FL T2-01* of 1 January 2019 described that the company did not conduct commercial flight operations with the Epic LT and that persons are only transported in accordance with the stipulations for General Aviation.

Chapter 5.21 *Уход на второй круг* (Go Around) stipulated that a PIC shall terminate an approach if it is not stabilised at 1,000 ft AAL at IMC or at 500 ft AAL at VMC.

The *Epic LT Airplane Flight Manual* Chapter 4.6 *Снижение и посадка* (Descent and Landing) described that in general approaches shall be conducted with flaps 14°. Airspeed with this flap position and extended landing gear should be 110-120 KIAS. For landings on short or wet runways the approach should be flown with flaps 40°. Due to the increased pitch angle compared with flaps in position 14°, the pilot has a better view of the runway and possible obstacles. Approach speed with this configuration with landing gear extended was stated as 90-100 KIAS.

Chapter 4.7 *Уход на второй круг* (Go Around) described the procedure as follows:

- Stop descent
- Power lever in position MAX PWR
- Commensurate with the airspeed increase pitch angle to 10°
- Flaps 14°
- Retract landing gear, do not exceed 135 KIAS
- Retract flaps fully
- Decrease pitch angle to 5°
- Increase speed to 160 KIAS
- Report to ATC

Chapter 4.11 *Особенности выполнения заходов на посадку по нестандартным схемам* (Specifics when conducting non-standard approaches) contained more stipulations. The text of this chapter was identical with Chapter 1.17 of the SOP for the Epic LT.

Non-standard approaches were therefore final approaches with approach angles of more than 3.5° or when the approach angle requires a rate of descent of more than 5 ms^{-1} (more than 1,000 ft/min). The rules in this chapter were recommended for final approaches with approach angles of more than 3.5° and were mandatory for final approaches with approach angles of more than 5.6°. Among other things, it was stipulated that prior to descent landing configuration (landing gear extended, flaps 40°), an airspeed of 90-100 KIAS should be reached and the autopilot be disengaged.

Chapter 5.3 of the AFM *Особенности пилотирования самолёта на критических режимах* (Specifics of aircraft control in critical flight conditions) described the aircraft's behaviour at or close to critical angles of attack and recovery.

Among other things, it was described that during bank over the wing, counter-control input with the aileron should be given immediately. If the rudder is activated in such a situation or when flying with stall speed, this may contribute to entering a spin. If a pilot tries to pull the control column, it is very likely that the airplane enters flat spin. It was estimated that stopping the flat spin is very difficult. To stop spinning, the rotation has to be stopped and the airspeed increased, so that the effectiveness of the rudder is restored and the descent is stopped.

Additional Information

Past Flights of the Aircraft to Frankfurt-Egelsbach

Airport documentation showed that the aircraft had landed at Frankfurt-Egelsbach Airfield on 21 November 2014 and on 14 March 2015.

According to the entries in the airplane's Journey Log, the accident pilot was listed as co-pilot on a flight from Moskow-Domodedowo to Frankfurt-Egelsbach on 14 March 2015.

Other Accidents at Frankfurt-Egelsbach

Between 2009 and 2019 four accidents occurred at Frankfurt-Egelsbach Airfield involving jet and turboprop aircraft. Based on Regulation (EU) No. 996/2010 and these accidents, the BFU compiled a study examining the flight operational characteristics at Frankfurt-Egelsbach Airfield and analysing similarities in regard to accident prevention.

Type Certificate Epic E1000

Approximately eight months after the accident, on 6 November 2019, the FAA issued the type certificate for the Epic E1000 based on the design requirements FAR23 (Type Certificate Data Sheet A00059SE).

The document contained the following entry concerning the compliance with the design requirements regarding spinning safety by installation of a stick pusher/shaker.

> *Equivalent Level of Safety Finding:*
>
> *FAR 23.221 Spinning by installing a stick pusher/shaker in accordance with ELOS Memo No. TC11773SE-A-F-1*

Analysis

General

The traces at the accident site and at the wreckage show that the airplane had impacted the ground with low horizontal speed, high vertical speed, a left bank angle and a left yaw movement. This corresponds with observations of several witnesses.

The sounds of a video recording of a witness, the determined damage at the propeller and the ingested soil in the engine prove that the engine was running at the time of impact.

Due to the destruction, examination of the wreckage was possible only to a limited extent. However, it did not reveal any accident-related technical malfunctions. Flap positions at the time of impact could not be determined with sufficient certainty, due to the high degree of destruction.

Mass and centre of gravity were within the prescribed limits.

At the time of the accident, visual meteorological conditions prevailed and had no causal effect.

Due to the injuries sustained during impact, the accident was not survivable for the occupants.

Actions of Persons

Pilot Actions

The radar data reveals that the pilot conducted the descent initially with a rate of descent of about 300 ft/NM (i.e. as 3° or 5% descent). This corresponds with the values common in General Aviation.

Prior to changing frequencies to Egelsbach INFO, the radar controller instructed the pilot to continue descent in order to approach Frankfurt-Egelsbach Airfield below airspace C of Frankfurt/Main Airport, which begins at 3,500 ft AMSL, and noted: “[…] to stay clear of airspace Charlie.” The pilot acknowledged the instruction, but temporarily entered airspace C.

The pilot neither read back the transponder code the Flugleiter had given him nor selected it.

The radar data of the airplane shows that being in descent and coming from south-east the aircraft entered this section of airspace C at about 2,500 ft AMSL, i.e. significantly above 1,500 ft AMSL. Approximately one minute later, at the position DELTA, the airplane was still at 1,900 ft AMSL. The two airspace violations in short order, the missing acknowledgement of the transponder code and not selecting it either suggest that in this phase the pilot had a high workload.

When the Flugleiter asked: “[…] do you have the field in sight?” the pilot answered: “Ah, not yet […].” At the time, the airplane was about 1 NM from the airport. The radar data reveals that a few seconds previously the airplane had turned north-east towards the airport. It is highly likely that the pilot had turned directly towards the airport due to the chart depiction on the multifunction display. After the pilot had acknowledged the Flugleiter’s remark: “I suggest to reduce, you are now on right base” he began the descent. In this phase, the pilot extended the landing gear. The radar data shows that during the approach the airplane remained too high.

Once the airplane was about 300 m south of runway threshold 08 at about 400 ft AAL, the pilot said: [unintelligible] approach“ and steered the aircraft into a left-hand turn.

Based on the radar data the curve radius was determined and a bank angle of about 30° calculated. This basically corresponds with the statements of witnesses. The BFU is of the opinion that the flight path the pilot chose, after the decision to terminate the approach, was not suited to result in a successful landing on runway 08. The fact that the airplane was turning so close to the extended runway centre line that a bank angle of more than 50° would have been required to reach the final approach makes this evident.

The pilot’s decision to turn left after he had terminated the approach could be explained with the better view of the runway from the pilot’s seat during a left-hand turn. The radar data does not reveal any indication that the pilot had initiated a go-around with the start of the left-hand turn and the subsequent radio communication with the Flugleiter: “[…] may I the […] make an orbit?” This becomes evident with the fact that during the left-hand turn, lasting for about 30 s, altitude and ground speed remained the same. This fact in combination with the choice of words during the radio communication indicates that the pilot’s intention was to reduce the extra altitude with the additional turn and then land.

It is very likely that during the turn the pilot tried to reach the final approach path to land on runway 08 without overflying the Autobahn. In the last phase he exclusively concentrated on seeing the runway and was therefore distracted from adherence to essential flight parameters such as pitch attitude, bank angle and speed. The investigation did not clearly identify any evidence that the pilot made the decision during the turn to go-around instead of landing and increased the engine power accordingly. However, this would have resulted in an additional left roll and yaw tendency, due to the rotation direction of the propeller.

The BFU is of the opinion that already during the descent to the traffic pattern altitude the pilot lost situational awareness, turned toward the airport without visual contact with the runway and in the further course of events reached his performance limits in the single pilot cockpit which ultimately resulted in loss of control.

Actions of the Flugleiter

The purpose of the stipulation to issue certain transponder codes to aircraft approaching Frankfurt-Egelsbach Airfield was to protect departing traffic of the neighbouring Frankfurt/Main Airport, to mark them as identified and as being in contact with Frankfurt-Egelsbach INFO.

In accordance with valid procedures, the Flugleiter assigned a transponder code via radio communications. He neither responded to the fact that the pilot did not acknowledge the code nor that the indication on the radar monitor did not change. Instead, he radioed the PA-28 crew and informed them of the fast approaching and then passing Epic LT and to clarify the approach sequence. This shows that he prioritised a quick solution of the impending conflict between the two aircraft. Due to communications problems, this interaction took about one minute where the Flugleiter's attention was focused on the PA-28. Contrary to valid procedures stipulated by the air navigation service provider, he deliberately refrained from having the Epic's pilot change the transponder code in order to not burden him more during the second approach.

The Flugleiter had noticed the too high altitude of the Epic LT on his radar monitor and advised the pilot of the maximum allowable altitude of 1,500 ft AMSL.

When the Flugleiter saw that the aircraft coming from the DELTA approach was flying with a north-east heading toward the tower, he asked the pilot if he had the airport in sight and then tried to support him by saying: "I suggest to reduce, you are now on right base" and „You are number one to land [...]".

After the termination of the approach, the pilot asked: “[…] may I the […] make an orbit?” The Flugleiter instructed the pilot to fly a left-hand turn but advised him to not overfly the Autobahn towards the west. Since the pilot had already turned left and no longer had the runway in sight, this instruction is not understandable. With this information he pointed out quite clearly that for this flying manoeuvre there is very little airspace available west of the airport up until the control zone.

Specific Conditions

The pilot has to be considered as very experienced, due to his total flying experience, his qualification as flight instructor for single engine aircraft and his type experience. The number of hours he had flown on type in the last several months on the aircraft in question show a good training level at the time of the accident. However, the pilot had been in Frankfurt-Egelsbach with this airplane just once, years previously. During that flight he had been the co-pilot. The BFU is of the opinion that he was not familiar with the specific conditions at the airfield.

The investigation did not reveal any indications as to health impairments or fatigue of the pilot at the time of the accident.

Due to the sharply inclined windshield and the elongated engine cowling, the view from the left-hand seat of the pilot to the right and down was limited. This and the direct approach to the airport contributed to the fact that he did not see the runway in time.

Defences

In the scope of this investigation, the term defences means technical systems, actions, procedures, and organisations which shall minimise the effects of technical or human error in regard to flight safety.

Stabilised Approach

The investigation of landing accidents in the past determined that a landing accident is often preceded by a non-stabilised approach. In order to prevent landing accidents, decision criteria for a stabilised approach were developed for pilots whose non-adherence at a so-called safety gate (1,000 ft AAL at IMC and 500 ft AAL at VMC) should result in termination of the approach. Analysis of the respective documents showed that adherence to the criteria for a stabilised approach had been stipulated

by the company. With the respective adherence, the pilot would have had to make a decision for a go-around.

Due to the steep approach angle of the APAPI of 4.4°, the approach to runway 08 of Frankfurt-Egelsbach Airfield was a non-standard approach, according to the SOP. Under consideration of this fact the pilot should have terminated the approach much sooner and instead of flying a turn close to ground should have initiated a go-around.

It cannot be ruled out that the high-ranking passenger, who wanted to go to Frankfurt together with her father and the fact that both were expected at Frankfurt-Egelsbach had increased the pilot's motivation to "force" the landing contrary to the stipulations of the SOP.

Stall Warning

The airplane was neither equipped with an angle of attack indication nor with a stall warning device which issues visual, acoustic or haptic warnings (stick pusher/shaker). The BFU does not have any detailed information whether the airplane indicates approaching the critical angle of attack through natural warning (e.g. aerodynamic buffet). The fact that in the scope of the certification of the Epic E1000, which is based on the Epic LT, an artificial stall warning device was installed argues against it.

Recovery

After the airplane had banked over the wing it was no longer possible to stop the uncontrolled flight attitude or level off, because the remaining altitude was too low.

Organisational Conditions

The BFU is of the opinion that the complex airspace structure surrounding Frankfurt-Egelsbach Airfield poses a great challenge for pilots. This is especially true for the operation of jet and turboprop aircraft.

During approach to runway 08, it is not possible for pilots of such jet and turboprop aircraft to adhere to the criteria for a stabilised approach. This is owed to the fact that the short distance between threshold runway 08 and the Autobahn A5 (running west of the airport) does not allow the pilots of these aircraft to be established at 500 ft AAL on an acceptable approach angle or on the 4.4° approach angle of the APAPI, respectively, once they have finished the final approach turn.

Adherence to the recommendation published in the AIP, Chapter 3.6 to start the final approach after having established visual contact with the APAPI indication at at least 1,300 ft AMSL and conduct it with a selected approach angle of 4.4° is in regard to landing direction 08 not possible, because this point would be within the control zone of Frankfurt/Main Airport.

Conclusions

The accident was caused by the pilot steering the airplane during a turn in low altitude in an uncontrolled flight attitude, the airplane then banked over the wing and impacted the ground in a spinning motion.

Contributing factors:

- The decision of the pilot to conduct a non-standard approach to runway 08 without visual contact with the runway and contrary to the SOP and to continue the unstabilised approach.
- The complex airspace structure surrounding Frankfurt-Egelsbach Airfield
- The late recognition of the airport and the pilot's decision for an inappropriate manoeuvre close to the ground.
- The insufficient attention distribution of the pilot in combination with the missing stall warning of the airplane.

Safety Recommendations

Safety Actions of the Manufacturer and the Civil Aviation Authority

During type certification of the Epic E1000 in accordance with FAR 23 by the FAA in November 2019, stick pusher/shaker were installed as part of the stall protection. In addition, the type is equipped with angle of attack indications in the cockpit.

The BFU will not issue any safety recommendations in regard to this issue, due to these actions.

Safety Recommendations

To prevent similar accidents with Epic LT aircraft, the BFU has issued the following safety recommendation:

03/2021

The Federal Aviation Administration (FAA) should ensure that the Type Certificate Holder of the Epic E1000 informs the operators of Epic LT aircraft in suitable form about the risks resulting from the missing stall warning and suggests actions to mitigate these risks.

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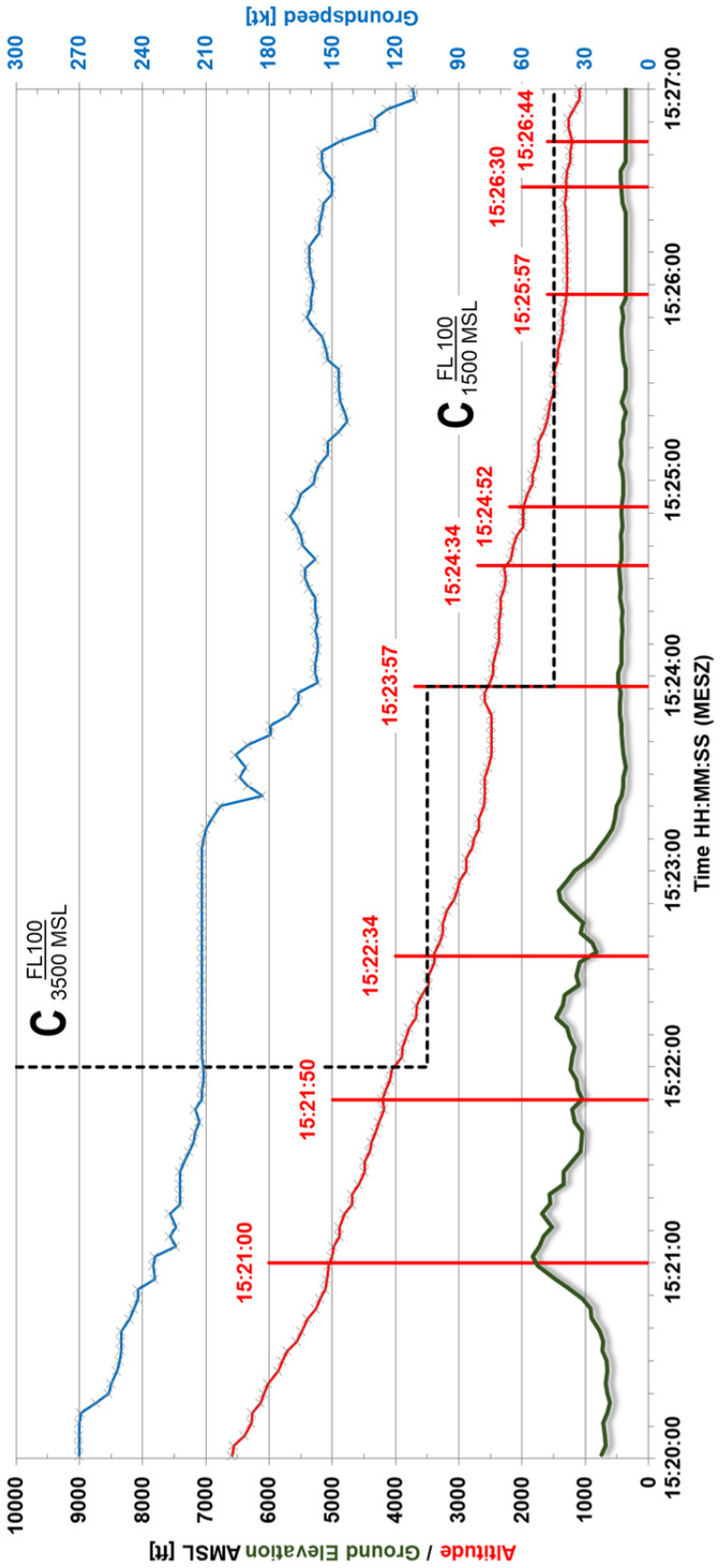
Field Investigation:	Uwe Berndt, Stefan Maser, Jens Friedemann
Reconstruction of the flight path	Ekkehart Schubert
Braunschweig:	29 December 2021

Appendices

Appendix 1 Vertical profile of the descent including airspace C boundaries

Appendix 2 Comment of the State of Registry and Operator regarding the investigation report

Appendix 1 vertical profile of the descent including airspace C boundaries



Appendix 2 Comment of the State of Registry and Operator regarding the investigation report

The State of Registry and State of the Operator significant comment

Reference to the draft Final Report (quotations from the Report are given in *italic*)

History of the Flight: "*According to the radar recording, at 1524:52 hrs the airplane reached position DELTA and turned right in northern direction toward the approach path to runway 08 of Frankfurt-Egelsbach Airfield*" (page 3).

Further, at 1526:44 it is said: "*the Flugleiter addressed the pilot: "[...] do you have the field in sight?"* And the pilot responded: "*Ah, not yet [...]*"". Then the Flugleiter informed the pilot where exactly the aircraft was in relation to the RWY 08: "*...you are now on right base.*" And further, at page 21 (Actions of Persons) when the Flugleiter asked: "*[...] do you have the field in sight?*", the pilot answered: "*Ah, not yet [...]*", the airplane "*was about 1 NM from airport.*"

"*At 1527:04 hrs, as the airplane was about 300 m south of threshold 08 flying a northeastern heading, the radio message "[unintelligible] approach", was recorded. From then on the airplane began to turn left*" (page 4). At this moment, the airplane was at about 400 ft AAL (page 21).

The State of Registry and State of the Operator opinion:

The actual flight path from DELTA to RWY 08 was significantly different comparing to the published approach chart of Frankfurt-Egelsbach Airfield. This is also confirmed by the actual flight path (fig. 3 *Excerpt of the visual approach chart of Frankfurt-Egelsbach Airfield with flight path of the aircraft*) and the radar recordings (fig. 4 *Flight path lateral and vertical with data of two radar stations in relation to runway 08*).

We believe that the pilot after the DELTA flyover was not performing the approach (was not following approach chart) but made decision to fly towards the RWY 08 with the purpose of making ***a visual contact with the said RWY***, and to fly approach maneuver after that.

We note that BFU has expressed almost the same idea at the page 22: "*The BFU is of the opinion that already during the descent to the traffic pattern altitude the pilot lost situational awareness, turned toward the airport without visual contact with the runway...*"

However, along the pages 21-22 one can see many references to the pilot's attempts to terminate the approach: "*The pilot's decision to turn left after he had terminated the approach...*" (page 21), "*...does not reveal any indication that the pilot had initiated a go-around with the start of the left-hand turn...*" (page 21), "*After the termination of the approach, the pilot asked…*" (page 22).

Our opinion is that the above statements used in the draft Final Report related to the pilot's decision to terminate the approach and perform a go-around, do not reflect the flight situation. The pilot after the DELTA flyover did not perform the landing approach therefore could not have terminated it. The pilot's intention rather was to fly towards the RWY 08 with the purpose of making a visual contact with it, and perform approach and landing maneuver after that (with the left-hand turn after overflying the RWY).

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.

Published by:

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