

Investigation Report

Identification

Type of Occurrence:	Accident
Date:	26 August 2013
Location:	Gerbach
Aircraft:	Ultralight Aircraft
Manufacturer / Model:	Evektor Aerotechnik a.s. / EV 97 Eurostar 2000 R
Injuries to Persons:	Two persons fatally injured
Damage:	Aircraft destroyed
Other Damage:	Crop damage
State File Number:	BFU CX014-13

Factual Information

History of the Flight

On 22 August 2013 the crew of an ultralight aircraft Eurostar with a Dutch registration took off from Grefrath Airfield for a flight to Tannheim. The plan was to spend several days in Tannheim.

According to witnesses it was intended that one pilot conducts the flight from Grefrath to Tannheim and the other the return flight. At 1433 hrs¹ the airplane landed in Tannheim. Afterwards the ultralight was refuelled.

On 26 August 2013 the return flight took place.

The crew established radio contact with Langen Information at 1020 hrs. At 1022 hrs the position of 17 Nautical Miles (NM) north of Ulm at 4,700 ft AMSL was reported. At 1039:01 hrs the crew reported the ultralight's position at 10 NM southeast of Schwabisch Hall at 3,000 ft AMSL; the encountered ceiling was also reported. Langen Information gave the crew weather information and pointed out, that another pilot had been at Flight Level (FL) 75 in the vicinity of Wurzburg above the clouds. At 1039:31 hrs the ultralight crew reported that they wanted to continue below the clouds towards Mannheim and "sich das ansehen wolle" (take a look at it). At 1039:40 hrs, Langen Information gave the information that north of Stuttgart towards Karlsruhe the weather was bad and other pilots had returned south. At 1039:51 hrs the ultralight crew acknowledged this information. Between 1059:51 hrs and 1245:42 hrs Langen Information tried to contact the ultralight crew nine times, but received no answer.

The radar data shows that after take-off the ultralight flew north along the river Iller. At 1039 hrs the control zone of Stuttgart Airport was passed to the south. In the area of Mannheim the recorded radar signals of the UL show changing headings, altitudes, and speeds. Speed decreased from 100 kt to 64 kt. The ultralight descended from FL67 to FL64 and then climbed again to FL69. The flight was continued with a north-western bearing and a ground speed of 100 kt. At about 1140 hrs the flight path showed s-shaped movements. The altitude varied between FL69 and FL65 and then climbed again to FL67. At about 1144 hrs approximately 6 NM prior to the accident site the ultralight descended to FL65 and the course changed to north. At 1148 hrs approximately 1.8 NM prior to the accident site, change of direction toward the north occurred with a 270° turn to the left. The last radar target of the ultralight was recorded at 1150 hrs at the vicinity of the accident site at FL67.

In the evening the destroyed ultralight was found. Both occupants had suffered fatal injuries.

¹ All times local, unless otherwise stated.

Personnel Information

The pilot in the left-hand seat was 75 years old and owner of the ultralight. He held a Dutch Flight Crew Licence (RPL (A)) issued in accordance with ICAO by the Dutch aviation authority (ILT). The type rating for the ultralight (MLA) was valid until September 2014. His class 2 medical certificate was valid to 17 April 2014. According to his pilot log book his total flying experience was 277 hours.

The pilot in the right-hand seat held a pilot's licence for aerial sports equipment valid until 5 May 2018 issued on 9 May 2003 by the Luftsportgeräte-Büro des Deutschen Aero Club e.V. (Bureau for Certification of Light Air Sports Devices at German Aeroclub, DAeC). He also held a valid Private Pilot's Licence PPL(A) issued in accordance with JAR-FCL by the Bezirksregierung Düsseldorf (District Council Düsseldorf) on 30 January 2004. It listed the SEP (single engine piston land) rating. His class 2 medical certificate was valid to 17 April 2014. His total flying experience was 528 hours.

Aircraft Information

The EV 97 Eurostar is a twin seat aerodynamically controlled ultralight aircraft in metal construction.

Manufacturer: Evektor Aerotechnik a. s.

Type: EV97 2000 R Eurostar

Manufacturer's

Serial Number (MSN): 2002 1530

Year of manufacture: 2002

MTOM: 450 kg

Engine: Rotax 912 ULS

Total airframe hours: 512 hours

The pilot owned the ultralight which had a Dutch certificate of registration. It was operated with a Dutch Special Certificate of Airworthiness. The owner conducted the maintenance work.

According to the weighing report of 5 December 2002 the empty mass was 296.4 kg. Prior to take-off in Tannheim it was refuelled with 53.32 l fuel. The objects on board had a mass of approximately 15 kg. According to the post-mortem report the occu-

pants had a total weight of 180 kg. The modifications on the trim lever, the tail wheel, and the landing gear's suspension weighed about another 2 kg. During the weighing on 5 December 2002 the modifications were not listed or noted in the equipment list.

The scope of work pertaining to the Technische Mitteilung (technical report) M-EV97-01/2009 and the Lufttüchtigkeitsanweisung (Airworthiness Directive) of the DAeC Luftsportgeräte-Büro LSG 09-004 (possible deviation from the required material quality) was conducted on 8 March 2010 by the manufacturer. Compliance with material thickness and characteristics was certified.

The airplane was equipped with an Emergency Locator Transmitter (ELT). The Search and Rescue (SAR) control centre Munster received a short signal, which was not sufficient to locate its source.

The ultralight was not equipped with a ballistic recovery system. For the operation of the aircraft in the Netherlands installation of such a system was not required.

According to the flight and operations manual the following values were valid for air-speed and flight performance:

Speed:

Speed		IAS		Remarks
		[km/h]	[kts]	
VNE	Never exceed speed	270	146	Do not exceed this speed in any operation.
VA	Manoeuvring speed	160	86	Do not make full or abrupt control movement above this speed, because under certain conditions the aircraft may be overstressed by full control movement.
VNO	Maximum structural cruising speed	190	103	Do not exceed this speed except in smooth air, and then only with caution.
VFE	Maximum Flap. Extending speed	125	67	Do not exceed this speed with flaps extended.

Weight

Empty weight (standard equipment)	275 kg ± 3 %	606 lbs ± 3 %
Max. take-off weight	450 kg	992 lbs
Max landing weight.....	450 kg	992 lbs
Max. weight of fuel.....	47 kg	104 lbs
Max. baggage weight	15 kg	33 lbs

Centre of gravity

Empty aircraft C.G. position (standard)	18±2 % MAC
Operating C.G. range	20-34 % MAC

The assumed weight and balance of the ultralight at the day of the accident calculated by the aircraft manufacturer:

W&B ANALYSIS OF EV-97 EUROSTAR, S/N 20021530				
Item	Item weight (kg)	Item arm (mm)	Moment (kg.mm)	Notes
Empty aeroplane	296,4	225,15	66734,46	W&B record 5.12.2002
Tail wheel (additional instal.)	0,8	3600	2880,00	estimated weight of wheel
Land.gear springs (additional instal.)	1,2	550	660,00	estimated weight of springs
Crew	180	500	90000,00	
Baggage	15	1270	19050,00	full baggage
Fuel at takeoff	46,8	920	43056,00	65 liters
Fuel at accident	23,76	920	21859,20	2 hours after takeoff
Approx. weight at takeoff:	540,2	C.G. (%MAC):	32,9	
Approx. weight at accident:	517	C.G. (%MAC):	31,1	540,2
MTOW limit (no BRS):	450	Aft C.G.limit:	34	
MTOW limit (with BRS):	472,5			
MTOW was exceeded		C.G. Was OK		

Calculation of the centre of gravity

Source: Manufacturer

“Minimum take-off mass was exceeded and the centre of gravity within the permissible range.

Meteorological Information

At Tannheim, the aerodrome of departure, weather information was available. According to witness' statements Dutch pilots used this weather information for their pre-flight preparation. Whether the two accident pilots used the weather service was not observed.

According to witness' statements overcast skies and extreme rainfall prevailed in the area at the time of the accident.

The flight path ran through GAFOR areas 72 (aerodrome of departure), 62, 53, 51, 44 to Grefrath Airfield, GAFOR area 31. The accident site was located in GAFOR area 44.

According to the statement of the Deutscher Wetterdienst (German meteorological service provider, DWD) the following forecast was issued for the time of departure in Tannheim for the flight path to Grefrath:

The weather forecast for General Aviation (GAFOR) of 0600 UTC:

Deutscher Wetterdienst

Flight weather overview Luftfahrtberatungszentrale Mitte (Meteorological Advisory Centre for Aviation)

Valid between 26 August 2013 0600 UTC to 26 August 2013 1800 UTC

Forecast area: GAFOR areas 24 to 28 and 37 to 64

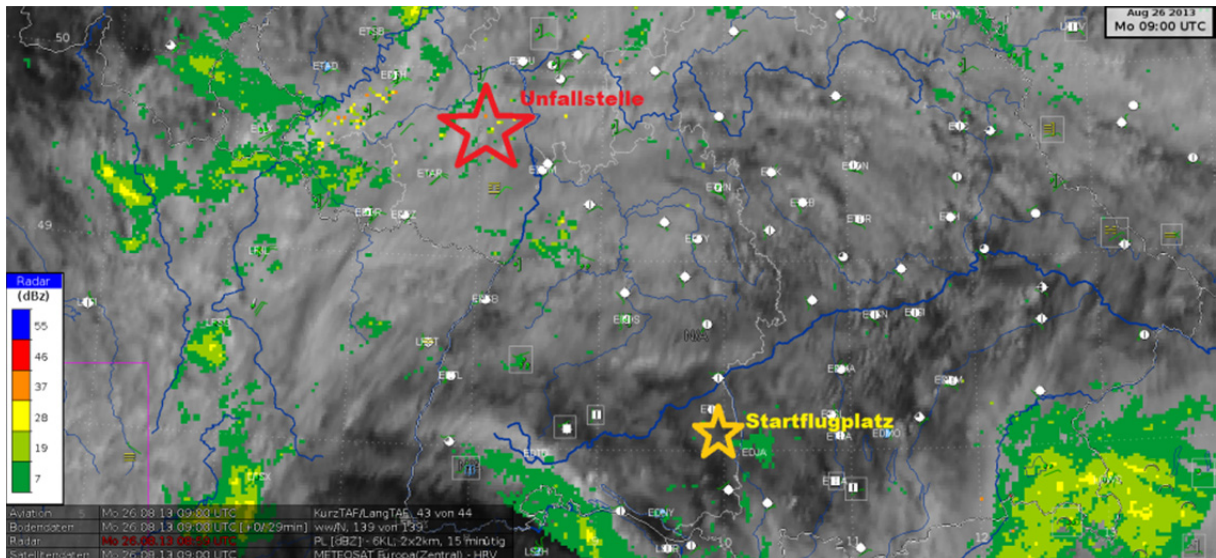
Weather conditions and changes:

A weakening low pressure system is moving from south-west Germany to France. An occlusion front is lying in zonal orientation over the forecast area. It divides dry and moderately warm air above northern Germany from damp unstable Mediterranean air above the Alps.

Weather pattern:

Widespread BKN SC/AC/CI with a base of 2,500 and 3,500 ft AMSL, in the north from FL060 to FL080. The cloud tops are at FL200, often above FL245. The mountains are partially in clouds, locally BKN ST has formed at 300 to 800 ft AGL. Temporarily light to moderate rain is falling; in the furthest north of the forecast area it is mostly dry. Visibilities are between 8 and 15 km, partially hazy at 2 to 6 km.

During the day precipitation lessens initially, around noon and during the afternoon it assumes shower characteristics. The clouds begin to form stratus clouds, locally ISOL EMBD CBs is to be expected. During the day the ceiling increases somewhat, visibilities by day are often 10 to 20 km, will locally be reduced to 4 to 8 km.



Weather radar image

Source: DWD

At the accident site stratus stratocumulus clouds with TOPS 40 and BKN OVC AC CI Maxtops at FL200 prevailed.

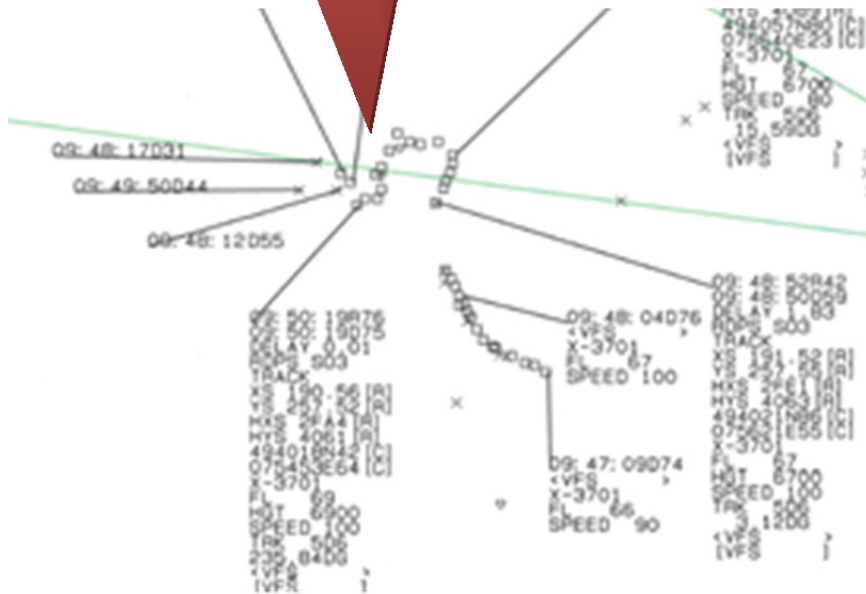
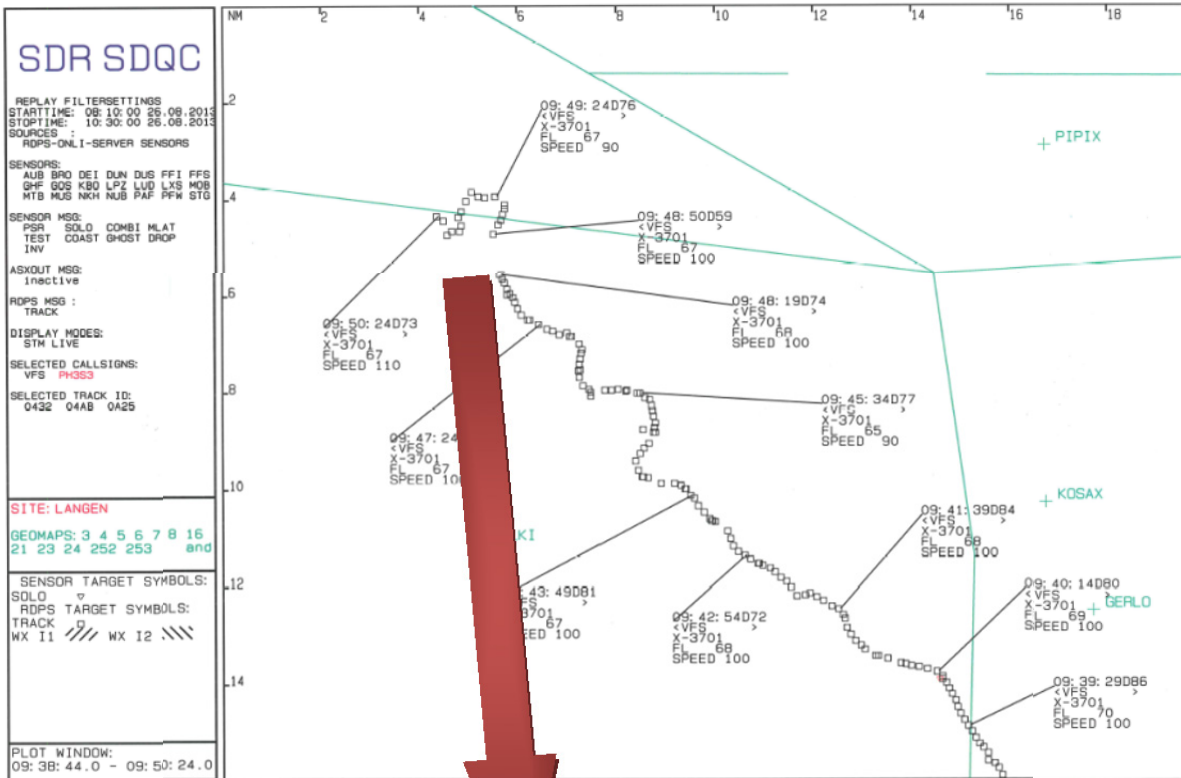
Radio Communications

There were radio communications between the Flight Information Service (FIS) in Langen and the crew. The radio communications were recorded and made available to the BFU as transcripts for evaluation purposes. Radio communications with the crew of the ultralight occurred in German.

Flight Recorder

The ultralight was equipped with a GPSMap Garmin 196 navigation system. The flight path data was not recorded.

The air traffic service provider radar data recording was available to the BFU for evaluation purposes. The engine monitoring system (FLYdat) recorded different engine parameters, such as oil pressure, oil temperature, and engine rpm (revolutions per minute). The BFU read out and analysed the FLYdat data.



Radar recording of the accident area

Source: DFS

Wreckage and Impact Information

The accident site was located in the vicinity of the village Gerbach on a wooded hilltop, on which a wind power plant had been erected. At 2045 hrs the first wreckage parts were found. The main wreckage was found at about 2245 hrs in a forest.



Wreckage distribution

Source: GoogleEarth / BFU

The wreckage parts were spread over a distance of approximately 1,300 m.

Approximately 700 m north-east of the wind power plant, the front fuselage part, consisting of engine and fire wall including instrument panel, stuck about 30 cm deep in the forest floor. The propeller blades had been torn off and were lying next to the front fuselage part. The middle section of the fuselage, including severed vertical tail, lay approximately 400 m north-east of the wind power plant. Both occupants were found in their seats wearing seat belts.

Both wings had been severed. The left wing had been torn off at the bracket. The right wing spar was attached to the fuselage and had been twisted downward toward the fuselage end. An Emergency Locator Transmitter (ELT) was lying next to the wreckage; the control unit had been torn out.

The torn out vertical tail was found approximately 55 m south-west of the wind power plant. The rudder was found approximately 80 m further south-east at the edge of the forest.

The right wing stood on its nose 213 m further south-east of the wind power plant in the forest. Another 50 m further to the south-east, the left wing was found lying on the forest floor.

Parts of the horizontal tail were found on the forest floor approximately 330 to 400 m south-east of the wind power plant.

Wreckage Examination

The wreckage was transported to the BFU for further investigation.

The following parties participated in the examination of the wreckage: The Dutch Safety Board, the Czech Air Accidents Investigation Institute (AAII), the manufacturer, and the authority tasked with the certification process.

The wreckage showed several modifications. An additional tail wheel had been fitted to the vertical tail. The trim lever had been fitted with an extension. Between the landing gear legs a coil spring had been added. Parts of the left wing and wing tip had been repainted. A lock wire on the bolt of the wing did not meet the requirements of the manufacturer. A bolt was secured with a regular safety pin.

Besides the repainting the wings did not show any other signs of repair.



Displayed wreckage parts

Photo: BFU

A fractured piece of the aft wing spar was attached to the right wing. The right main wing spar was attached to the fuselage and bent like a corkscrew. The leading edge of the wing had ruptured open and was severed from the wing spar. The rivets were torn out. The right wing root section was deformed.

An approximately 10 cm large piece of the aft wing spar cap was attached to the



Right wing

Photo: BFU

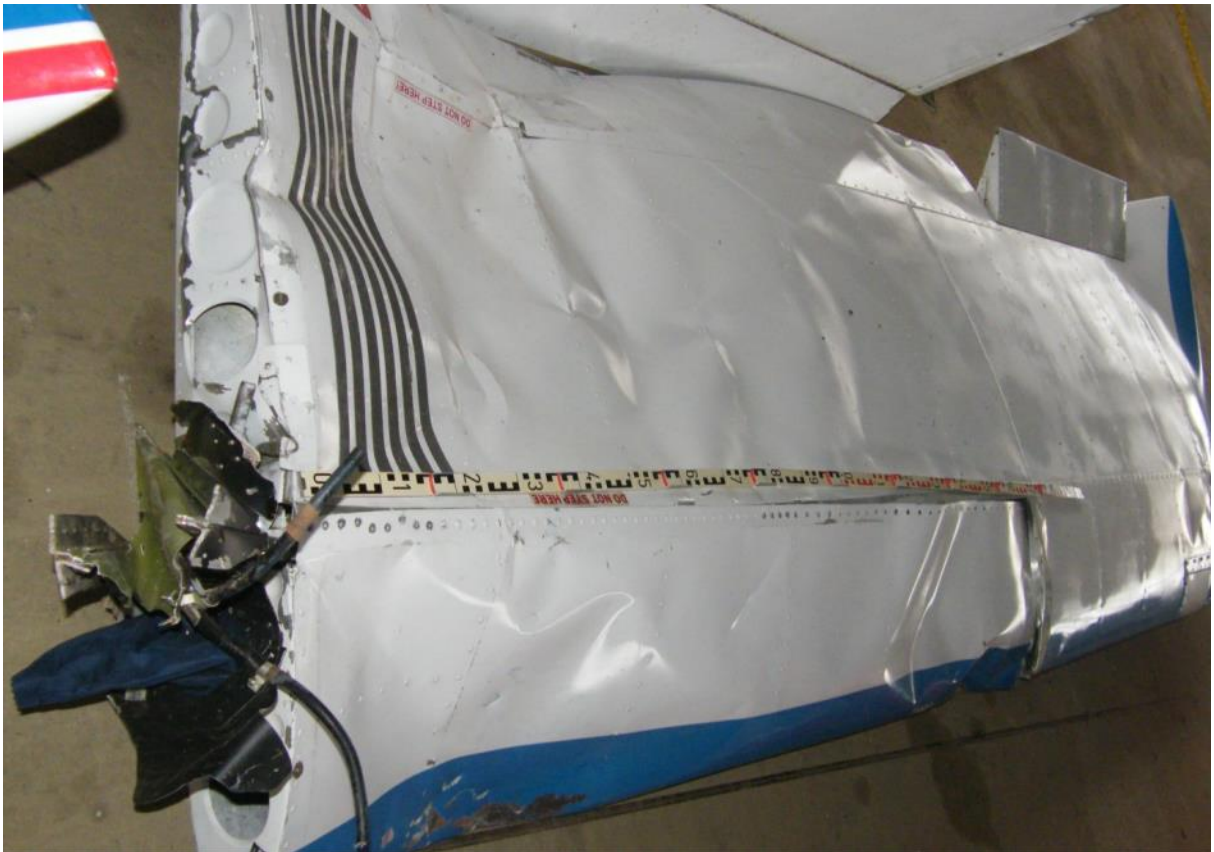
wing. A torn-out piece of the wing root was attached to the wing spar.



Aft right wing clamp

Photo: BFU

The leading edge of the left wing was dented about 30 cm prior to the wing spar web. Blue colour was found on the wing upper surface in the area of the wing spar. The outer area of the wing had been repainted.



Left wing

Photo: BFU

The wing spar had been shorn off at the fuselage area and its fracture surface was deformed. The aft support wing spar had been torn out of the wing.



Left wing main wing spar

Photo: BFU



Front fuselage section

Photo: BFU

The front fuselage section had been torn out of the fuselage. The rivets were torn out also.

Engine examination

The BFU read out the data of the engine monitoring system (FLYdat).

Engine Type: Rotax 912S EVANS

Serial No.: 4428480

CADAT No.: 00029

Date of Configuration.: 12.11.2002

Channel Input	Max: Warning Alarm	Min: Warning Alarm
1 SPEED.....	05800	06000
2 EGT/PTO RIGHT.....	+0880	+0900
3 EGT/PTO LEFT.....	+0880	+0900
4 OIL TEMP.....	+0130	+0145
5 OIL PRESSURE.....	0006.0	0008.0 0002.0 0001.0
6 EGT/MAG RIGHT.....	+0880	+0900

7 EGT/MAG LEFT..... +0880 +0900
8 CHT..... +0135 +0150

OPERATION DATA:

Hours of Operation (Total/TBO): 00574.6/0574.6 Next Service: 1200.0

Time/Ch.:	1	2	3	4	5	6	7	8
I 0574.6	04960	+0650	+0631	+0083	0003.9	+0718	+0729	+0088
O 0574.6	06960	+0732	+0705	+0084	0004.4	+0807	+0808	+0088

Except for the reporting interval 0574.6, all other engine parameters of the flight were within tolerances. During the recording interval engine rpm increased to 6960 UPM, then the recording ended.

The engine manufacturer stated that for this engine no problems had been reported.

Medical and Pathological Information

A post-mortem examination was performed on the deceased crew members. The injuries they had sustained were due to the impact. No indications for pre-existing illnesses, which could have impaired their performance, were found.

Fire

There was no fire.

Survival Aspects

Both occupants had worn seat belts. The ultralight was not equipped with a ballistic recovery system. The accident was non-survivable for the occupants due to the high impact forces.

Additional Information

The ultralight had been based in Germany for a longer period of time. During the winter months the owner had disassembled the ultralight and stored it in the Netherlands.

According to witnesses the owner had conducted the maintenance work. The engine was maintained by a Motorseglerwart (motor glider technician). The annual inspections (certificate of airworthiness) were conducted regularly.

Witnesses reported about two prior damages on the wings. A dent on the wing leading edge was caused when transporting the ultralight. Damage also occurred during ground contact while landing. The owner repaired the wing sheeting and tip. The owner classified both damages as minor. Witnesses saw several landings at Grefrath where tailstrikes occurred.

In 2009 the area of the trailer, where the wings were stored for the transport of the ultralight, was raised by 15 mm to prevent tension.

The maintenance documentation did not show any reports of structure repairs of the wings. No spare parts for the repair of the ultralight were ordered from or shipped by the manufacturer.

The engine manufacturer did not have any indication of engine damage in his documentation. Spare or maintenance parts were not ordered from the engine manufacturer.

The owner made modifications to the landing gear, the fuselage, and the trim without consulting the manufacturer. Consultation and a changed weighing report, as stipulated by the flight and operations manual chapter 8.3, were not documented.

The flight and operations manual did not contain any description as to how to proceed after a hard landing or tailstrike.

Analysis

Pilots

Both occupants held valid licences and ratings to conduct the flight. As agreed, for the return flight the seating positions had been changed. The flying experience of the 75-year-old pilot of 277 hours had to be considered as insufficient for the continuation of the flight above the closed cloud cover. The passenger in the right-hand seat had 528 hours of flying experience and was the more experienced of the two pilots.

Flight Weather

The weather was difficult for the planned flight to Grefrath. The decision of the pilots to fly above the clouds in order to later land under CAVOK conditions in the destination area was one possible option, which required a flight above a dense blanket of clouds. The decision was made in the area of Mannheim. The cloud tops were at FL40 and individual tops at FL200. At the time of the accident, heavy rain fell in the accident area, which indicates individual high cloud tops. The s-shaped flight path after Mannheim can be viewed as an indication for the avoidance of high cloud tops.

Technical Examination

The aircraft had a Dutch certificate of registration. On 8 March 2010 the manufacturer conducted a material examination due to their technical report M-EV97-01/2009. The threshold value for airworthiness of 375 MPa was exceeded. Therefore, there were no impairments of material characteristics and quality which could have contributed to the accident.

The engine examination revealed no technical malfunctions except for the excess rotation speed at the time of the accident. Therefore, the speeds were above the maximum speed for manoeuvres with full rudder extension, V_A 86 kt, and within the maximum strength-related cruising speed, V_{NO} 103 kt. The recorded engine speed of 4,960 rpm in cruising level corresponds with an indicated airspeed of 167 km/h or 90 kt.

The ultralight's structure was weakened by the damages on the wings. The owner had painted the wings with different paint during the winter months while repairing the damages. No documentation of repairs on the wings was found. The aircraft examiner did not document any repairs of the wings in the inspection certificate. It is not known whether the aircraft examiner was informed in its entirety of possible damages. The annual inspection is about a visual and metrological inspection of the aircraft.

The modifications on the trailer for the wing storage during transport shows, that at least in the beginning other damages of the wings might have occurred.

The manufacturer was not consulted regarding damage analysis. The landings the witnesses had observed, which resulted in modifications of the landing gear leg and fuselage, might have contributed to structural damage. The additional tail wheel and springs on the landing gear leg show that the pilot had difficulties operating the aircraft.

The flight and operations manual did not contain any note regarding the inspection of fuselage and landing gear after hard landings. The BFU is of the opinion that the owner was not aware of the effects the modifications and wing damages had on the aircraft structure. The repairs he had done himself indicate an overestimation of one's own capabilities and insufficient knowledge concerning aircraft maintenance.

The take-off mass was beyond permissible limits. At the time of take-off the ultralight had a take-off mass of 540.20 kg and therefore had an overweight of 90.2 kg or 20%. Neither the flight and operations manual nor the certificate of registration allowed overweight operation (flights above MTOW). At the time of the accident, approximately after two hours of flight, the ultralight still had an overweight of 14,9%.

Accident Sequence

Based on the damages the possible sequence of the in-flight break-up of the aircraft was reconstructed.

Individual Actions

A flight above a dense blanket of clouds requires a high degree of concentration. Besides the technical skills, flying and operation of an aircraft, the non-technical skills are playing an important role. Situational awareness increases with life and flying experience of the pilot. Knowledge and skills such as determination of the spatial position or assessment of the aircraft's parameters and environmental conditions are developed. One other important factor is time. The comprehension is important as to how much time is available until a certain event occurs or in what time period a certain action has to be completed. With increasing age the capacity of reaction is diminishing. The BFU is of the opinion that for this particular flight and the prevailing weather conditions the situational awareness of the pilot was not developed enough.

The analysis of the flight path and the radio communications with Langen Information indicate that it had not been planned from the beginning to fly above a dense blanket

of clouds. Continuing the flight with the prevailing weather caused stress for the crew. The BFU is of the opinion that the pilot's capabilities to adequately react in the situation were diminished. The decision to continue the flight above a dense blanket of clouds instead of landing prior to the weather front in Mannheim was neither right nor wrong. The situation they were in was interpreted incorrectly. This resulted in overwork in the cockpit, which the pilots no longer realised logically consistent and target oriented.

It is highly likely that during the flight above the cloud cover a loss of control occurred. The flight path was not straight but characterised by several changes of direction. In the final phase of the flight a clear avoidance manoeuvre was conducted. The BFU is of the opinion that this was an attempt to avoid towering clouds rising from the blanket of clouds. It is highly likely that the pilot flew into even worse weather conditions in the process. Due to his insufficient qualification to fly in difficult weather conditions, including visual limitations it is likely that loss of spatial orientation (vertigo) occurred during an avoidance manoeuvre. The speed control of the aircraft was lost. The maximum speed was exceeded which resulted in structural failure.

Conclusions

The accident was due to an uncontrolled flight attitude in bad visual meteorological conditions, which resulted in structural failure. The left wing broke off, the fuselage structure broke up, and the right wing detached from the main wing spar.

Contributory factors:

- The low flying experience of the pilot
- Insufficient qualification to fly an ultralight across a dense blanket of clouds
- The under-developed situational awareness of the pilot for the flight above a dense blanket of clouds
- Prior damage to the wings
- Significant overweight of the ultralight

Investigator in charge: Knoll

Field investigation: Eisenreich, Knoll, Koos, Sammet

Braunschweig: 21 December 2016

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.

Published by:

Bundesstelle für
Flugunfalluntersuchung
Hermann-Blenk-Str. 16
38108 Braunschweig

Phone +49 531 35 48 - 0
FAX +49 531 35 48 - 246

Mail box@bfu-web.de
Internet www.bfu-web.de