

Investigation Report

Identification

Type of Occurrence:	Accident
Date:	23 May 2010
Location:	Near Mönchgrün
Aircraft:	Helicopter
Manufacture / Model:	Fairchild Hiller / FH 1100
Injuries to Persons:	Pilot and three passengers fatally injured
Damage:	Aircraft destroyed
Other Damage:	Crop damage
Source of Information:	Investigation by BFU
State File Number:	BFU CX004-10

Summary

History of the Flight

The pilot had his own approved landing and take-off site in Moßbach from which he made a total of three local flights, each with three passengers. An accident occurred during the third flight at approx. 1630 hrs¹.

Witnesses observed the helicopter approach at low level in a northerly direction from the village of Möschlitz. They heard a change in sound west of the village of Mön-

¹ All times local, unless otherwise stated

chgrün and gained the impression that something had failed. They saw how the helicopter veered towards the woods to the west of Mönchgrün; a few seconds later they heard the sound of an impact. One witness observed how the helicopter suddenly fell headfirst vertically out of the sky.

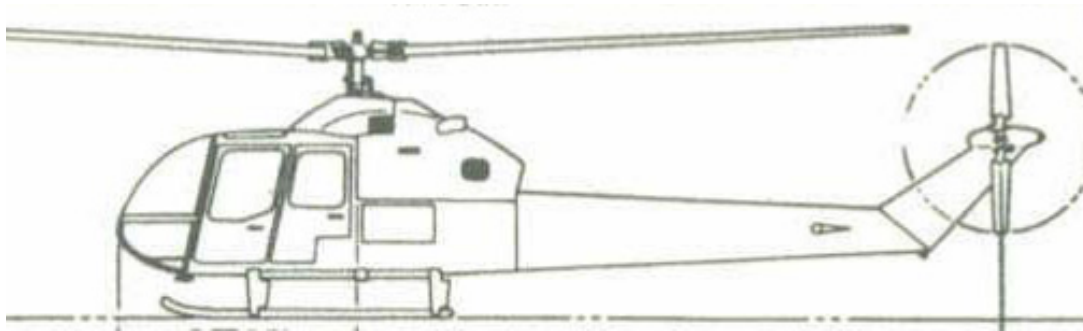
Personnel Information

The 49 year-old pilot had a Private Pilot's Licence (PPL(H)) issued in accordance with JAR-FCL 2, first issued on 16 June 2008 and valid to 30 May 2013. His R22 and R44 helicopter rating as Pilot in Command (PIC) was valid to 30 May 2010. He also had a Private Pilot's Licence (PPL(A)) and microlight. He also had an FAA Temporary Airman Certificate / Private Pilot issued on the basis of his German JAR-FCL 2 licence. His Class 2 Medical Certificate was without limitations and issued in accordance with ICAO and JAR-FCL 3 regulations and was valid to 29 April 2012.

The instructor, who had trained the accident pilot on the FH 1100, and the records held by the regional civil aviation authority, indicated that the pilot had total helicopter flight time of about 100 hours, of which about 12 hours were on the type in question. The three flights on the day of the accident were the first the pilot had made alone after completing his training on type with the instructor. The pilot's personal logbook was not available for inspection.

Aircraft Information

The FH 1100 is a five-seat helicopter made by Fairchild Hiller and was produced from 1963 to 1973. It has landing skids, a two-blade main rotor and a tail rotor mounted on the vertical tail rotor mast to counteract main rotor torque. The maximum gross weight is 2,750 lbs. The helicopter is powered by an Allison 250-C18 turbine engine. This helicopter type has only an American Type Certificate (TC No. H2WE). The data sheet states that 1.6 gal (6,056 litres) of the fuel in the tank are unusable.



Side-view FH 1100

Image: Fairchild Hiller

The FH 1100 helicopter in question was manufactured in 1968 and bore the manufacturer's serial number 92. The weighing report dated 28 August 2009 gave the empty weight as approx. 1,650 lbs. The helicopter airframe logbook indicated that it had flown approx. 2,588 hours. The most recent 100-hour check had taken place on 30 August 2009 at 2,576.5 hours. The annual inspection for renewal of the Certificate of Airworthiness was dated 01 September 2009.

The helicopter was registered in the United States of America. The helicopter's 'Aircraft Bill of Sale' documented that it was acquired by the accident pilot on 29 October 2009. However, the US owner registry stated that on this day, the helicopter was still registered in the name of the vendor, a US citizen residing in Germany, who also certified the continuing airworthiness validity. The US Federal Aviation Agency (FAA) has advised that a further 24 aircraft with US American registrations were registered in the name of this individual.

In 2003, the then owner in the USA presented the helicopter to the type certificate holder for a 100-hour check and annual inspection. Inspection of the helicopter's technical records identified the absence of any history for a number of airframe and engine components, or determined that they were time-expired. In 2003, the type certificate holder subsequently documented the helicopter's airworthiness. A number of components that had been faulted in the 2003 inspection were found in the helicopter wreck.

The flying instructor who had familiarised the accident pilot with the helicopter stated that the fuel gauge had operated and gave a normal indication. Also, he had observed no technical irregularities during the familiarisation flights, for which the helicopter had been refuelled with diesel from containers. The flying instructor stated that he had calculated endurance on the basis of fuel consumption of about 65 litres per hour.

The copy of a FH 1100 handbook was found in the helicopter, but had been issued for another helicopter with a different registration and manufacturer's serial number. This handbook contained no information about the estimated hourly fuel consumption. More recent publications issued by the current type certificate holder and an accident report from the National Transportation Safety Board (NTSB), give the hourly consumption as about 22 gallons (83 litres).

One witness stated that in his presence and about two weeks prior to the accident, the pilot had completely drained the helicopter fuel tank to check the accuracy of the fuel gauge readings.

On the day before the accident the pilot purchased 601.38 litres of diesel fuel and 60 litres of unleaded petrol at a local petrol station and used this to replenish the mobile fuel trailer in his hangar.

The Allison 250-C18 engine is cleared for use with a wide variety of fuels, in an emergency including AVGAS. Automotive diesel fuel is not approved.

Meteorological Information

The following weather observations were made by the automated weather station in the village of Schleiz 30 minutes after the accident:

The wind was from 310 degrees at about 6 kt. The visibility at ground level was 22 km with slight cloud at 4,600 ft, 6,000 ft and 7,000 ft. The temperature was 18 °C and dew point 11 °C. The air pressure (QNH) was 1020 hPa.

Aerodrome Information

The helicopter took off from the pilot's own approved landing and take-off site in the village of Moßbach. It was approved for use until 31 December 2010 by the Thüringen regional planning authorities under section 25 of the Federal Aviation Act. The site had a hangar for the helicopter and a mobile fuel trailer.

Flight Recorders

The helicopter was not equipped with a Flight Data Recorder (FDR) or Cockpit Voice Recorder (CVR), nor were recorders required by law.

It was not possible to reconstruct the flight path taken by the helicopter using radar data. The local air traffic service provider had no trace of either a secondary target/transponder return, or a primary radar return that could be associated with the helicopter. Two cameras were found in the wreck and their films were developed. The resulting photos gave a partial indication of the route taken.

Passengers in the previous two local area flights had taken photos and video films, which were made available to the BFU for this investigation.

Three of these photos gave an indication of the quantity of fuel then remaining in the aircraft.

Picture No.	Flight Phase	Time (On-board clock)	Quantity of fuel indicated	Indicated Airspeed
1	Commencement of first local flight	17:11	40 gallons level 25 gallons cruise	115 MPH
2	End of first local flight	17:24	23 gallons level 13 gallons cruise	108 MPH
3	End of second local flight	17:49	6 gallons level 2 gallons cruise	< 40 MPH

Wreckage and Impact Information

The accident site was northwest of the village of Mönchgrün on the western edge of a field with an early crop sown in firm soil. The helicopter came to rest on the right side of the fuselage with the skids pointing towards the woods on the field western edge. The four fatally injured occupants were found immediately adjacent to the helicopter.

All parts of the wreckage were found within a small, limited area around the helicopter main wreck. Impact marks from the main rotor, the rotor mast, the cabin and tail rotor were found directly alongside the main wreck. The main rotor was found underneath the helicopter, with rotor blades straight and only slightly deformed. The rotor head had separated from the rotor mast, and the main gearbox had torn loose from within the airframe cell. The control rods had separated from the swash plate and the rotor head and were jammed. The upper surfaces of engine exhaust pipes and en-

gine cowling were compressed and dented. The engine compressor housing was bent to one side and had partly broken off; the combustion chamber was dented and the engine could not be rotated manually. The main drive shaft had broken off from the main gearbox.

The cabin roof and doors were destroyed and scattered about the wreck. The instrument panel was badly damaged; some individual instruments were missing or were destroyed and scattered about the wreck. The N1-tachometer instrument had jammed at 19%. The tail boom upper side and the rear third lower surface were dented. The tail rotor universal joint gearbox was found in the tail boom; it had oil and moved freely. The tail rotor gear had torn off and remained attached to the control wires. One tail rotor blade had detached and was found close to the boom on the ground near impact marks.



The accident site

Photo: BFU

First aid helpers who attended the site, and the BFU accident investigators who arrived later, said there was no smell of fuel; nor did any large quantity of fuel or oil leak from the wreck. The helicopter wreck was erected to expose the rubber bladder fuel tank on the left hand side, but less than two litres of fuel could be drained.

At the accident site, investigators disconnected the fuel lines to the engine and combustion chamber and fuel was drained.

After the wreck had been recovered, investigators examined the engine chip warning detectors. There were a number of chips in the oil sump. The fuel injector jet was unscrewed for examination and found very dirty. Fuel was found in the engine-side oil filter. The filter housing contained brown impurities.



Detailed photos: chip warning detector; fuel filter housing; fuel injection jet Photos: BFU

Medical and Pathological Information

A post-mortem examination of the pilot at the University-Clinic of Jena found no evidence of a health condition that would have affected his flying ability.

The pathological tests included those to identify the presence of alcohol in the blood, the presence of drugs, medication or carbon monoxide that would have affected the pilot's flying ability. The tests for the presence of drugs, medication and carbon monoxide were all negative. The test for alcohol detected the presence of 0.4 parts per thousand alcohol in the muscle tissue. It was stated from the clinic that parts of the alcohol can be the result of a starting putrefaction process.

Fire

There was no fire.

Survival Aspects

The impact energy was such that the accident was not survivable.

Tests and Research

As part of the investigation into the technical aspects of this incident, components were sent for examination by the Institute for Materials Science at Braunschweig Technical University and the engine manufacturer. Their investigations produced no new information.

The helicopter instrument panel incorporated a caution panel with warning lights. Individual light bulbs were sent for microscopic examination to determine whether and which were illuminated at the time of impact.



The helicopter's caution panel

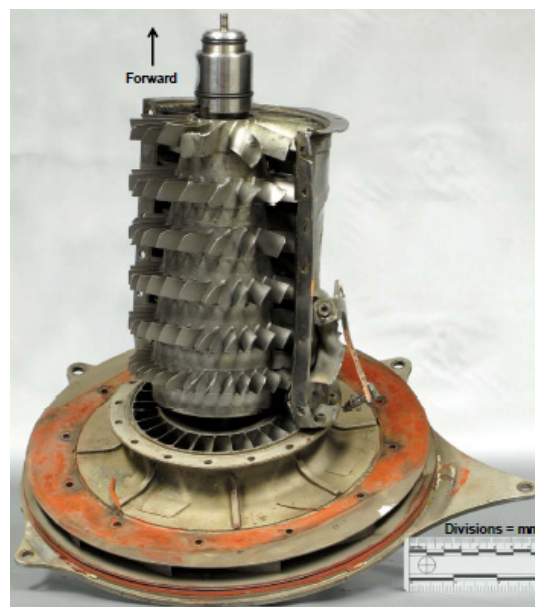
Photo: BFU

The examination had the following findings:

Warning Lamp	Bulb 1	Bulb 2	Remarks
ENG AREA HOT	OFF	OFF	-----
XMSN OIL TEMP	OFF	OFF	-----
FILTER	absent	OFF	-----
PRI HYD	OFF	OFF	-----
ENG OUT	ON	indistinct	Glass black
XMSN OIL PRESS	ON	ON	-----
FUEL PRESS	ON	ON	-----
SEC HYD	ON	ON	-----
GENERATOR	OFF	indistinct	Bulb filament slightly elongated

The helicopter's engine was disassembled in the presence of the manufacturer's representative. Each component was individually examined. There was no evidence of an in-flight engine failure.

After opening the bent compressor housing, inspectors found that some of the compressor blades were bent against their direction of rotation.



Compressor with blades bent against the normal direction of rotation

Photos: Rolls-Royce

Organisational and Management Information

The pilot kept the aircraft in a purpose-built hangar in the Moßbach industrial estate. In an interview with a local newspaper reporter he said he planned to offer local pleasure flights, business flights and other services with the helicopter. His plan had been to show the helicopter at a 'hangar party' to be held on 30 June 2010 to coincide with publication of the newspaper report. Witnesses stated they had won tickets for pleasure flights in a draw associated with a local motor racing track, the *Schleizer Dreieck*. The local City Mayor had told the press she was pleased that a new helicopter business was to be established in the vicinity and could have acted as an economic driver to the industrial estate. However, no approval had been issued under section 20 of the Federal Aviation Act and JAR-OPS 3.

The hangar also accommodated an approx. 700-litre mobile fuel trailer for the helicopter. Witnesses stated that it was not functioning on the day of the accident, for which reason the pilot had improvised refuelling until the first pleasure flight passengers arrived.

The US Code of Federal Regulation (CFR) 14, Part 47 regulates who may register an American-registered aircraft:

(a) An aircraft may be registered under 49 U.S.C. 44103 only when the aircraft is not registered under the laws of a foreign country and is

(1) Owned by a citizen of the United States;

(2) Owned by an individual citizen of a foreign country lawfully admitted for permanent residence in the United States;

(3) Owned by a corporation not a citizen of the United States when the corporation is organized and doing business under the laws of the United States or a State within the United States, and the aircraft is based and primarily used in the United States

[...]

Additional Information

Following the accident, the helicopter's earlier private owner made contact with the BFU. He stated, he had found conflicting documentary evidence with respect to the helicopter's flight times and serial numbers of components fitted, and had therefore returned the helicopter as not airworthy to the vendor -- a technical maintenance organisation -- on 10 October 2009. The company specialised in the sale and maintenance of US-registered aircraft.

A comparison of the old flight time summary with that produced for the previous annual inspection threw up a number of discrepancies. At the time of the last 100-hour check, the previous weighing and annual inspection, the helicopter was parked at the vendor company, but was actually in the possession of the earlier owner. However, the latter stated he had not commissioned, approved or paid for the work claimed by the vendor company. Further, the helicopter documentation was in his home and was unavailable to the vendor company for reference or inspection.

The previous owner stated that the fuel gauge readings fluctuated greatly, for which reason he had used flight times when estimating the remaining fuel.

Another local newspaper journalist made contact with the BFU. He had planned to write an article about the pilot and new arrival of a helicopter in Thüringen. Four days prior to the accident, the journalist held a 30-minute tape-recorded interview with the pilot. He made the tape recording available to the BFU. In the interview, the pilot stated the helicopter's fuel consumption as about 65 litres per hour and had an endurance with full fuel of about three hours.

Analysis

The pilot was in possession of a Private Pilot's Licence. He had little experience flying helicopters in general or the type in question. The passenger flights made on the day of the accident were the first he had made without a flying instructor. Post-mortem examination of the pilot found a blood alcohol concentration of 0.4 parts per thousand. In road traffic 0.3 parts alcohol per thousand is considered to generate a relative unfitness to drive. It cannot be debarred that the starting putrefaction process was the source of the alcohol.

The helicopter was registered in the USA. Investigation of the available documents, statements made by the previous owner, and findings by the type certificate holder in 2003, raised doubts about the helicopter's continued airworthiness. Examination of the engine also raised doubts as to whether it had been correctly maintained. The helicopter had flown about twelve hours between the previous inspection and the accident. Further, although the pilot had paid for the helicopter, he did not have title to the aircraft nor was he owner in the formal sense. The registration procedure, maintenance and operation in Germany, did not satisfy the American requirements and procedures of the Federal Aviation Administration (FAA).

The weather had no effect upon the flight. It was good and did not limit visibility.

The engine stopped during flight as confirmed by witnesses, observations at the accident site, examination of the warning light bulbs, and the findings on the engine. The pilot probably reacted to the engine failure with an attempt to restart the engine. This inference is supported by the fact that, post accident, the engine N1 tachometer had stopped at 19%; also the damage pattern to the compressor blades, and that fuel was found in the filters and fuel lines. Either the pilot did not initiate an autorotation or was too late in so doing, as a result of which the main rotor speed dropped off, the helicopter became uncontrollable and crashed.

With great probability, engine failure was due to fuel exhaustion. The handbook found in the wreck gave no indication of the expected fuel consumption. During training a too low fuel consumption of about 65 litres per hour was taught. Prior to the accident, the pilot had drained the fuel tanks and measured its contents to determine the accuracy of gauge readings. Fuel gauge readings fluctuated greatly, depending upon the fuselage attitude. There were two rough scales, one for the helicopter at rest, and a second for the helicopter in flight. It is suspected that the pilot had a false sense of security. In addition, the fuel tank contained a residual amount of unusable fuel. The mobile fuel trailer was not working on the day of the accident and the refuelling arrangements were improvised. It is highly probably that the pilot ceased refuelling the helicopter when the first pleasure flight passengers arrived.

Photographs taken during the flight confirm the tank contents were low. Very little fuel was found remaining in the tank after the accident, and this was badly polluted. The fuel did not meet the engine manufacturer's requirements, but it was not possible to determine whether this fuel had any detrimental effect on engine reliability or consumption. The engine manufacturer advises that the engine would probably start less easily and would have higher fuel consumption.

Conclusions

The accident occurred following a failed autorotation, or the failure to initiate an autorotation, after the engine stopped due to fuel exhaustion.

Safety Recommendations

Given the irregularities found in the helicopter documentation and the suspicion that this was not an isolated incident, the BFU has informed both the American Federal Aviation Agency and the German Public Prosecutor in accordance with section seven

of the German Aircraft Accident Investigation Law (§ 7 *Flugunfall-Untersuchungs-Gesetz*).

Following its own enquiries, the FAA found information that led to the compulsory de-registration and grounding of all aircraft registered to the vendor. The FFA opened a legal process against the individuals concerned to revoke their American licenses. The premises of the maintenance organisation were searched under warrant, during which many aircraft components were found without the necessary documentation. As a result, the FAA is planning to issue a Safety Alert for Operators (SAFO) to all aircraft operators about the use of components that were purchased from this maintenance organisation.

Investigator in charge: Axel Rokohl
Assistance: Uwe Berndt, Dietmar Nehmsch
Field Investigation: Uwe Berndt, Axel Rokohl
Braunschweig: 04. July 2011

This investigation was conducted in accordance with the Federal German Law on 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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