

Investigation Report

CX007-0/00
January 2002

Factual Information

Kind of occurrence: accident
Date: 09. August 2000
Location: aerodrome 'Griesheimer Sand'
Aircraft: aeroplane
Manufacturer/type: Cessna Aircraft Company / C 340
Injuries to persons: pilot and two passengers fatally injured
Material damage: aircraft destroyed
Other damage: field damage

editor:

Bundesstelle für
Flugunfalluntersuchung
(Federal Bureau of Aircraft
Accidents Investigation)
Hermann-Blenk-Straße 16,
D-38108 Braunschweig

mail: box@bfu-web.de
<http://www.bfu-web.de>
Phone: 0 531 35 48 0
Fax: 0 531 35 48 246

distribution:

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The investigation has been conducted in compliance with the Law Relating to the Investigation into Accidents and Incidents Associated with the Operation of Civil Aircraft (Flugunfall-Untersuchungs-Gesetz - FIUUG) dated 26 August 1998.

According to this Law, the sole objective of the investigation shall be the prevention of future accidents and incidents. It is not the purpose of this activity to apportion blame or liability or to establish claims.

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Summary

On August 9th, 2000, at 1450 hrs Central European Summer Time*, the Federal Bureau of Aircraft Accidents Investigation (hereafter referred to as BFU) was informed by the Air Navigation Services Frankfurt of an accident to a Cessna 340 aircraft at Griesheim near Darmstadt. On the same day, two staff members of the BFU started the investigation at the accident site.

Within the scope of a ferry flight from the U.S.A. to Germany, on August 9th, 2000, the aeroplane was on the last flight leg from Zweibrücken to Egelsbach. Shortly before reaching the aerodrome of arrival, a situation arose which prompted the pilot to perform an emergency landing on the special airfield Griesheim. During the turn for an approach to runway 25 the aircraft stalled over the left wing and crashed on the ground. Immediately the aircraft caught fire and burnt out. All three occupants lost their lives in this accident.

The investigations revealed that both engines had malfunctioned because of fuel shortage. The calculated remaining fuel, which should have been left in the tanks, obviously was not available to supply the power plants.

The accident happened because during the approach to land on runway 25 at Griesheim the aircraft turned to the left (with the left-hand power plant stopped and the propeller not in feathered pitch) at an airspeed below the minimum airspeed.

* Unless otherwise specified all times are indicated in Central European Summer time (CEST).

1. Factual Information

1.1 History of the flight

On 9. August 2000 at 14:03 hrs the aeroplane departed from Zweibrücken for the flight to Egelsbach. It was a flight under visual flight rules without a flight plan at an altitude of 5000 ft. At 14:19 hrs, the pilot-in-command first contacted the radar controller responsible for the sector Egelsbach. At 14:33 hrs, the radar controller granted the necessary entry clearance and instructed the pilot to contact Egelsbach Information (130.900 MHz). At 14:33:22 hrs the pilot called Egelsbach Information. At 14:34:29 he declared that he had a problem the cause of which he could not find out. At 14:35:25 the pilot announced via radio that he would perform an emergency landing at Griesheim. There was no further radio contact.

The aeroplane flew a large turn over Griesheim, in order to land on the former military aerodrome. The aeroplane was rolling heavily at a very low airspeed with an uneven engine noise. Having arrived above the airfield, the aeroplane flew a left turn at a height of appr. 30 m, in order to land on runway 25. The bank angle was reported to have been between 40° and 60°. In this flight attitude the aeroplane stalled over the left wing and crashed with the left tip tank on the ground, it nosed over and immediately caught fire (Attachment 1).

1.2 Injuries to persons:

All three occupants were killed in this accident.

1.3 Damage to aircraft:

The aeroplane was heavily damaged by the ground impact and was destroyed by the fire.

1.4 Other damage

The accident caused field damage because of leaking fuels and lubricants.

1.5 Personnel information

Pilot-in-command:

Age and sex: 51 years/male

Nationality: German

Licence: Private Pilot Licence (PPL) issued in 1976 in Germany.

In 1992 acquisition of an American Commercial Pilot Licence (CPL)

Ratings: single and multi-engined landplanes

instrument flight rating (IFR)

At the moment of the accident, the ratings were valid

Flight experience: total flight experience appr. 1829 hours
of which appr. 295 hours on two-engined aeroplanes.
appr. 28 hours on the accident type

In the spring of 2000 the pilot had prepared theoretically and according to statements of witnesses very thoroughly on the basis of the Airplane Flight Manual (OWNER'S MANUAL) for the aeroplane type Cessna 340. His friends described him as a careful and reliable pilot who had already flown several aeroplane types and had sufficient flight experience. The Cessna 340 was a new type for him.

The pilot flew this aeroplane type for the first time in June 2000 in the U.S.A. accompanied by an instructor. The ferry flight, which had been planned already for this period of time, was postponed to August due to technical problems. At the beginning of the ferry flight, the pilot had a flight experience of appr. 5 hours on the accident type.

1.6 Aircraft information

Manufacturer/type: Cessna / C340
Year of manufacture / serial number: 1973 / 0217
Power plant manufacturer / type: Continental / TSIO-520-SER
Total time in service of the aircraft: appr. 4800 hours

The aeroplane had been certificated in the U.S.A.

1.6.1 Fuel system

The aeroplane was equipped with two auxiliary tanks in the wings and a wing locker tank in the left-hand engine nacelle. The main fuel tanks are the wing tip tanks (Attachment 3).

For each side of the aeroplane a tank selector switch is provided. When switching over to another tank it is to be ensured that the tank selector switch is locked in the correct position in order to achieve an optimum fuel supply. The indication of the fuel quantity is always related to the tank selected for the time being.

By means of the fuel tank selector switch, cross feed from the main tanks to the power plants can be switched, i.e. the left power plant can be supplied from the right main tank and vice versa. There is no direct connection between the tanks.

In order to achieve a safe fuel supply from the main tanks to the power plants, a main tank transfer pump is installed in each of these tanks in order to ensure a safe fuel feed by the fuel feeder pump in the main tank. This pump is fused via the circuit breakers of the landing lights.

During take-off and landing the power plants shall be supplied with fuel from the main tanks (tip tanks), i.e. the left-hand power plant from the left main tank and the right-hand power plant from the right main tank. With auxiliary tanks of a capacity of 31.5 gallons each installed, the fuel is to be taken from the main tanks for a period of at least 90 minutes following the take-off, before switching over to the auxiliary tanks. This is necessary for capacity reasons because with fuel

taken from the auxiliary tanks the fuel not consumed by the power plants will be fed back to the main tanks. It is not possible to pump the fuel directly from the auxiliary tanks into the main tanks. Only the fuel in the wing locker tank may (and must) be fed by means of a transfer pump to the left main tank.

The design of the fuel system with only one wing locker tank in the left wing means that the left wing contained appr. 75,7 litres (20 gal) more fuel than the right side. In addition the aeroplane cabin heating is supplied from the right main tank so that during flight the fuel in the right wing will be consumed first unless the right power plant is temporarily supplied in addition from the left main tank by switching the right fuel selector over to 'LEFT MAIN TANK', in order to compensate for the excess fuel quantity in the left wing.

maximum tank capacity	gal	litres	kg	lbs
2 main tanks (tip tanks) 50 gal	100	379	273	602
2 auxiliary tanks (wing tanks) 31.5 gal	63	239	171	377
1 wing locker tank (left side) 20 gal	20	76	55	120
total quantity:	183	694	499	1099

1 gal = 3.7856 l

density = 0.72 kg/l

1 kg = 2.2045 lbs

During the flight the aircraft mass and the centre of gravity position were within the allowable range.

1.7 Meteorological information

At the moment of the accident the weather was fine. Visibility was more than 10 km, the sky was slightly covered with clouds and there was a light wind from southwest.

1.8 Aids to navigation

not relevant to the accident

1.9 Communications

Radio communications were conducted in German; a transcription has been made. The radio communications did not give any information about the cause of the accident.

1.10 Aerodrome information

The aerodrome Griesheimer Sand is a special airfield located appr. 15 km south of the planned aerodrome of arrival Egelsbach near Frankfurt. The aerodrome has an asphalt runway of 1100 m length in the direction east - west (250°/070°).

1.11 Flight Recorders

There was no flight recorder aboard the aircraft.

1.12 Wreckage and impact information

The aeroplane first touched the ground with the left wing tip tank. The tip tank was torn off by the impact and slung 25 m further into the extended direction of flight. The aeroplane turned over the left wing about the yawing axis and crashed vertically on the ground with the power plants and the cabin; during the crash the right tip tank was torn off as well. The fuselage snapped off behind the cabin and the vertical tail crashed into the cabin roof.

Afterwards, the tail unit snapped back again. The aeroplane came to rest in normal attitude with the tail unit pointing northwest. According to statements of eyewitnesses there were several explosions. The cabin and the left wing had completely burnt out (attachment 2). The left power plant had separated. The right wing was in very good condition as well as the rear part of the fuselage and the tail unit. Both propellers had broken off behind the hub. The landing gear was extended. The flaps were in retracted position. The trim tab of the rudder was deflected to the left. Following the accident both fuel selector switches in the cockpit had been found in the position 'CROSS FEED' whereas the fuel selector valves in the wings were in different positions, the left valve was in the 'OFF' position and the right valve was in an intermediate position between OFF / MAIN TANK. The different positions of the fuel selector switches as well as the fuel selector valves show that with the impact the forced fuel assignment had been cancelled. Thus it is not possible to draw well-founded conclusions from the positions found. It could no longer be reconstructed from which tanks the power plants had been supplied during the approach to Egelsbach.

As a result of the fire fuel could be found neither in the tanks nor in the fuel lines nor in the fuel distributors on the power plants.

1.13 Medical and pathological information

The autopsy revealed that all three occupants had died of the injuries suffered in the impact. The results of the doxological examinations were negative.

1.14 Fire

With the impact, sparks were produced and inflamed the remaining fuel in the wings (impact fire).

1.15 Survival aspects

The accident was not survivable.

1.16 Tests and research

1.16.1 Investigation of the power plant

The power plants were investigated in an aeronautical workshop. One staff member of the power plant manufacturer (Continental Motors), one staff member of the aeroplane manufacturer (Cessna Aircraft Corporation) and one staff member of the BFU participated in the investigation.

After removal of the sparking plugs both power plants could be rotated smoothly. The sparking plugs showed evidence of normal combustion. A compression test indicated normal compression in all cylinders.

Due to the damage caused by the fire, an investigation of the fuel system was not possible.

The left propeller had completely been separated from the power plant. The propeller blades did not show any impact traces. The blades were not in feathered pitch. The propeller pitch control

mechanism did not show anything abnormal.

The blades of the right propeller showed clear impact traces on the leading edges. They were in low pitch.

1.16.2 Calculation of the remaining fuel.

The records show that the aeroplane had been refuelled for the last time on August 8th, 2000, in Newcastle with 474 lbs (299 litres) of fuel. It is to be supposed that at the departure from Newcastle the aeroplane contained the maximum fuel quantity of appr. 1099 lbs (appr. 694 l).

The flight time from Newcastle to Brussels was 02:03 hours. The flight was conducted in flight level 110. The average fuel consumption was assumed to be 190 lbs/h. In accordance with the table in the OWNERS MANUAL 12 minutes of flight with a fuel consumption of 76 lbs were assumed for the climb. For the remaining flight time of 01:51 hours a consumption of 352 lbs had been calculated. The fuel consumed during taxiing had not been considered. According to this, the aeroplane had consumed appr. 428 lbs for the flight from Newcastle to Brussels.

The flight from Brussels to Zweibrücken on August 9th, 2000, was conducted in 5000 ft and took 50 minutes. According to the documents, 6 minutes of climb with a consumption of 52 lbs had been assumed. For the remaining 44 minutes a consumption of appr. 140 lbs had been calculated so that 192 lbs of fuel were consumed on this flight leg.

The flight from Zweibrücken to the accident site at Griesheim was also conducted under visual meteorological conditions in 5000 ft and took 32 minutes. The climb was again assumed with a duration of 6 minutes and a consumption of 52 lbs. The consumption for the remaining flight time of 26 minutes was calculated to be 83 lbs so that 135 lbs of fuel were consumed on this flight.

Thus it is to be assumed that at the moment of the accident appr. 344 lbs (217 l) of fuel were aboard the aeroplane.

1.16.3 Evaluation of radar data

The flight track of the aeroplane had been recorded by the radar station Frankfurt North (FFN). The data transmitted were evaluated with the BFU. First the track went past the later accident site and afterwards in a left turn led back to the accident site. The distance from the aerodrome of destination was approximately twice the distance from the emergency landing aerodrome (Attachment 4).

1.17 Organizational and management information

not relevant to the accident

1.18 Additional information

1.18.1 Information about the ferry flight

The aircraft of the type Cessna 340 had been bought in the U.S.A. as a used aircraft and was to be ferried to Egelsbach.

The ferry started on August 5th, 2000, in Carrollton (Georgia) with the acceptance of the aeroplane by the pilot charged by the new owner. Two other persons were aboard the aeroplane, one of them held an English pilot licence and had a flight experience of appr. 200 hours, of which 118 hrs on two-engine aeroplanes. The same day the ferry flight, which was to be conducted in 5 flight legs,

was started. The flight to England was characterized by power plant troubles. In Reykjavik the oil system of the left power plant had to be refilled as a major quantity of oil had been lost on the flight from Narsarsuaq (Greenland) to Reykjavik.

On the flight from Reykjavik to Stornoway the left power plant had to be switched off appr. 100 NM from the coast due to oil system problems. The pilot conducted the remaining flight with one power plant running and landed safely and without any further problems at Stornoway. On this flight leg the aeroplane was accompanied by a helicopter of the Coast Guard. The technical defect was found and could be eliminated.

On the same day the flight to Newcastle was continued. In Newcastle the aeroplane was completely refuelled for the last time.

At 19:35 hrs UTC the aeroplane departed under an IFR flight plan to Luxemburg with Brussels as the alternate. As Luxemburg Airport had already been closed due to work on the runway, the pilot decided to fly to the alternate, where the aeroplane landed at 21:38 hrs UTC. From Brussels, the pilot phoned the aeroplane owner and told him that after the departure from Stornoway they did not have any more problems with the aeroplane and everything went off according to plan.

On August 9th, 2000, at 08:45 hrs UTC, the aeroplane departed from Brussels to Zweibrücken, where it arrived at 09:40 hrs UTC. During the stop at Zweibrücken, the pilot phoned the aeroplane owner once again and told him that the aeroplane functioned properly now and there were no more problems with the power plant. The arrival at Egelsbach was scheduled for 15:00 hrs.

1.18.2 Statements of witnesses

Witnesses made the following statements concerning the course of the accident:

Witness: 1

From the motorway restaurant Pfungstadt, the aeroplane was observed at appr. 14:20 hrs flying along the motorway A5 in the direction of Frankfurt at a height of appr. 750 ft. The aeroplane was banked to the left by appr. 25° and its flight was very instable. The witness had the impression that the aeroplane flew with only one power plant running.

Witness: 2

At appr. 14:30 hrs a man was on his way in the forest area of Pfungstadt in the direction of Griesheim, when he heard an aeroplane above him coming from the south. He heard an engine going out and starting again several times. He could not see the aeroplane.

Witness: 3

A woman living in Griesheim saw the aeroplane flying over Griesheim and heard a stuttering engine noise.

Witness: 4

Two witnesses, who conducted biological investigations at Griesheim aerodrome, saw the aeroplane approaching from the south very slowly at a very low height; step by step it lost height and rolled heavily. It flew a left turn into the direction of the runway. During this turn the aeroplane stalled over the wing and with this wing touched the ground. Afterwards it crashed with the fuselage nose and exploded.

Witness: 5

At appr. 14:30 hrs a witness, who was at the motorway crossing Darmstadt in his car, joined the tangential route in the direction of Mannheim, when he saw an aeroplane in front of him at a distance of appr. 300 m and appr. 20 m above the tree tops coming from the south and suddenly flying a sharp left turn from the pilot's point of view, during which it touched the ground with the left wing and crashed. Prior to the crash he had not observed any peculiarities concerning the aeroplane.

1.19 Investigation techniques

Special investigation techniques have not been applied.

2. Analysis

2.1 Flight operations

The statements of witnesses produced an almost complete reconstruction of the history of the flight from the beginning of the incident up to the crash. The evaluation of radar data confirms the statements made by witnesses concerning the flight track of the aeroplane. Especially the statements of two witnesses who heard a stuttering engine noise and the engines going out and restarting several times indicate that there were power plant problems.

In view of this situation the pilot decided to conduct an emergency landing on the special airfield Griesheim. He flew a wide left turn around the aerodrome for an approach to runway 25. The turn was flown with the left engine inoperative and the propeller not feathered. Due to this fact, the drag was considerably increased on one side and it was difficult to control and pilot the aeroplane under these circumstances. Caused by the loss of height resulting from the turn with reduced power the runway had to be approached under an angle of 90° to the landing direction. Eyewitnesses told about rolling movements and a stepwise loss of height. Obviously, the pilot endeavoured to reach the runway and therefore approached the runway directly from the south. The change of direction of appr. 90° to the landing direction at a distance of only 300 m from the touch down point was a manoeuvre which was difficult to fly under these conditions.

2.2 Aircraft

On the basis of the technical investigation it is to be assumed that both engines had malfunctioned because of an insufficient supply of the power plants with fuel; the cause of this fuel shortage could not be clarified. The problems related to the in-flight losses of oil can definitely be excluded as a reason why the power plants had malfunctioned.

As fuel could not be found in the wreckage any more it is assumed on the basis of the fuel calculations that at the moment of the impact a sufficient quantity of fuel had been in the tanks. As a result of the traces of the fire it is assumed that nearly all of this fuel quantity was in the auxiliary wing tanks.

Due to the high degree of destruction in the cabin area and the left wing, the controls in this area could no longer be investigated for function ability. Based on the statements of the witnesses and the course of the flight it is assumed, however, that the controls of the aeroplane were completely intact up to the impact.

During the investigation it was found that the trim tab of the rudder had been deflected heavily to the left, i.e. that the aeroplane was trimmed as if only the right-hand powerplant had been running.

3. Conclusions

3.1 Findings

- The aeroplane had been registered in the U.S.A. and according to the statement of the FAA properly certificated for operation.
- At the moment of the accident the aeroplane was operated within the allowable operational limits.
- The pilot had a valid licence with a valid instrument rating.
- The aeroplane had been refuelled for the last time at Newcastle.
- The maximum fuel tank capacity was 1099 lbs (693 l).
- In addition to the auxiliary tanks in both wings the aeroplane had a 'wing locker tank' in the left wing with a capacity of 120 lbs (76 l).
- The flight from Newcastle to Egelsbach was conducted with two intermediate stops and one stay overnight at Brussels.
- The flight to Egelsbach was conducted under Visual Flight Rules at an altitude of 5000 ft.
- The pilot contacted 'Egelsbach Info' south of Egelsbach near the entry point 'DELTA'; shortly afterwards he reported problems with his aeroplane and that he would carry out an emergency landing at Griesheim.
- The aeroplane was seen above the motorway A 5 coming from the south and making rolling movements with a bank angle to the left.
- The aeroplane flew a left-hand traffic circuit around Griesheim aerodrome during which witnesses perceived engine trouble.
- Step by step the aeroplane lost height and rolled heavily.
- When turning into the landing direction 25 at Griesheim, the aeroplane stalled in a left turn and touched the ground first with the left tip tank.
- Both propellers had been torn off and lay separately from the wreckage.
- The left propeller did not show any signs of rotation prior to the impact whereas the blades of the right propeller had clearly visible impact traces.
- The left propeller had not been set to feathered pitch.
- The right-hand propeller was in low pitch.
- The landing gear was extended.
- The flaps were in retracted position.
- The trim tab of the rudder was deflected to the left.
- The cabin area and the left wing had been completely destroyed by the fire.

- The main fuel tanks had been torn off and lay separately from the wreckage; they had been submitted only to slight heat effects.
- The left fuel selector switch was found in the position 'RIGHT MAIN TANK' and the right fuel selector switch in the position 'LEFT MAIN TANK'.
- The left fuel selector valve in the wing was in 'OFF' position.
- The right fuel selector valve was in an intermediate position between 'OFF' and 'MAIN TANK'.
- According to the fuel calculation appr. 344 lbs (217 l) of fuel still had to be aboard the aircraft.
- The investigation of the power plants has not revealed any technical deficiency

3.2 Causes

The investigations revealed that both engines had malfunctioned because of fuel shortage. The calculated remaining fuel, which should have been left in the tanks, obviously was not available to supply the power plants.

The accident happened because during the approach to land on runway 25 at Griesheim the aircraft turned to the left (with the left-hand power plant stopped and the propeller not in feathered pitch) at an airspeed below the minimum airspeed.

4. Safety Recommendation

none

5. Encl(s):

Attachment 1	View of the accident site from the air
Attachment 2	Views of the wreckage
Attachment 3	Fuel system of the Cessna C 340
Attachment 4	Evaluation of the radar data
Attachment 5	Right and left main fuel tanks

Braunschweig, 31.01.2002

Bundesstelle für Flugunfalluntersuchung (Federal Bureau of Aircraft Accidents Investigation)

by order

L. Müller

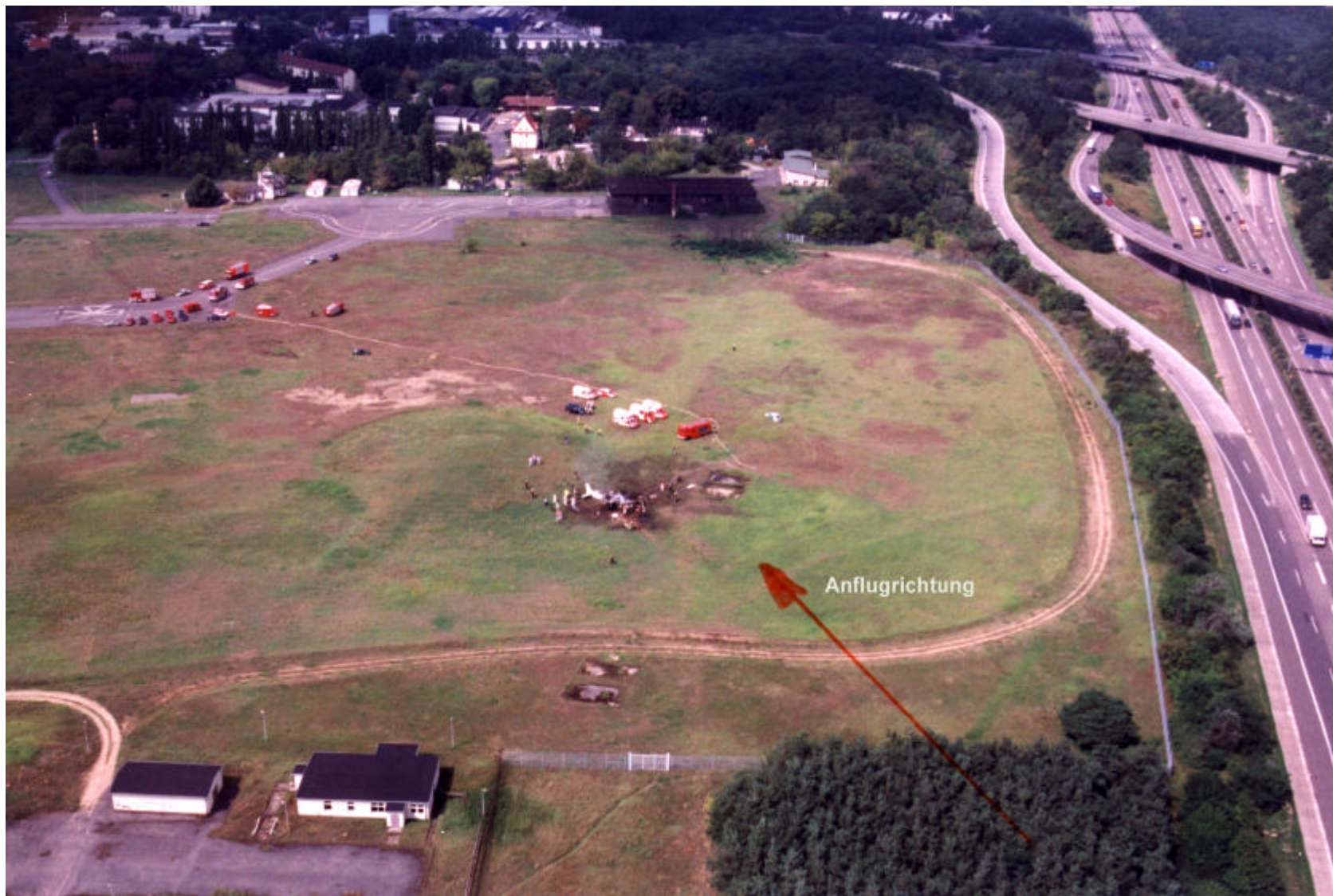
Investigator-in-charge

The following BFU staff members have contributed to the investigation:

Hans Peters Air Traffic Control

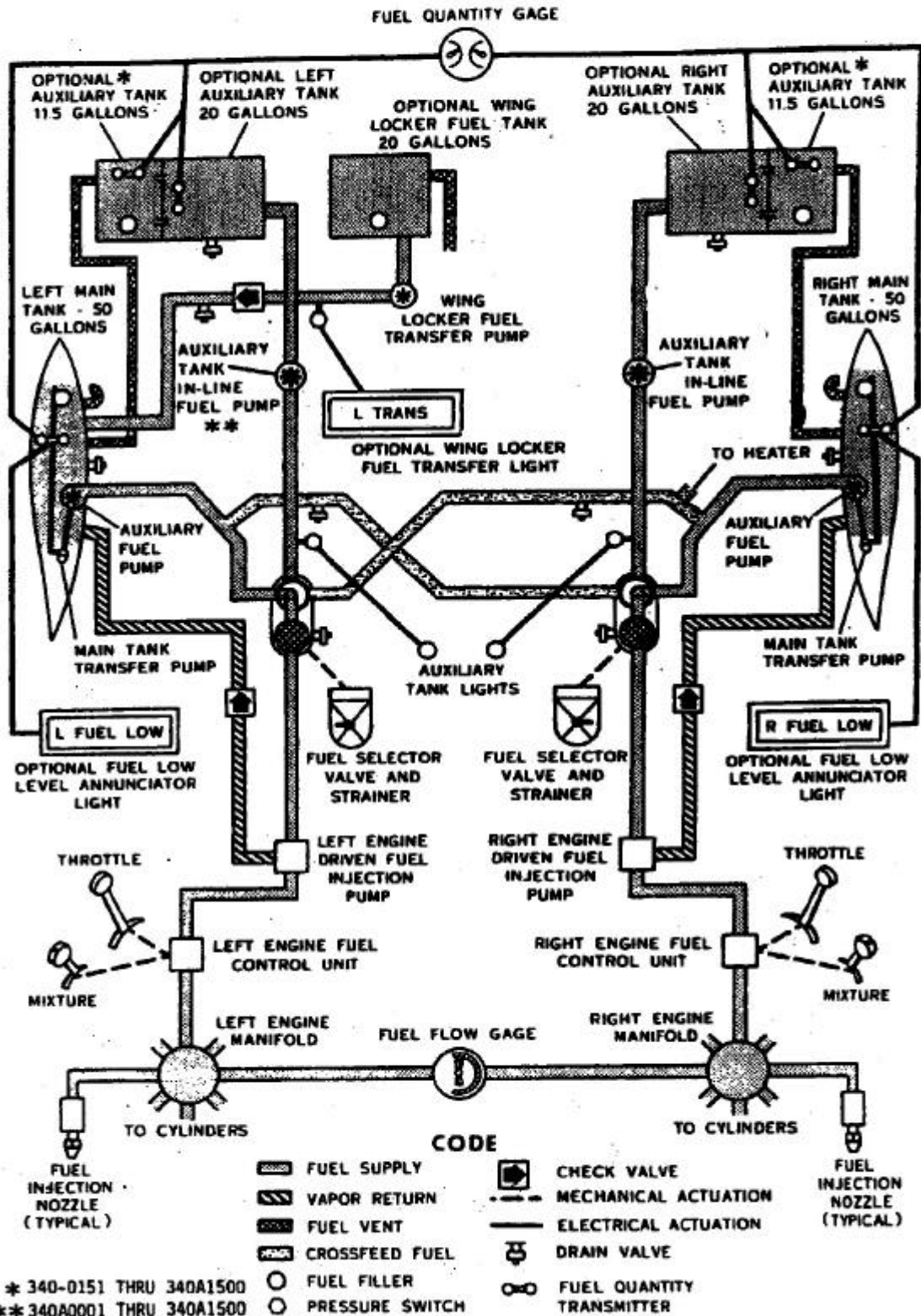
George Blau evaluation of radar data

View at the scene of the accident

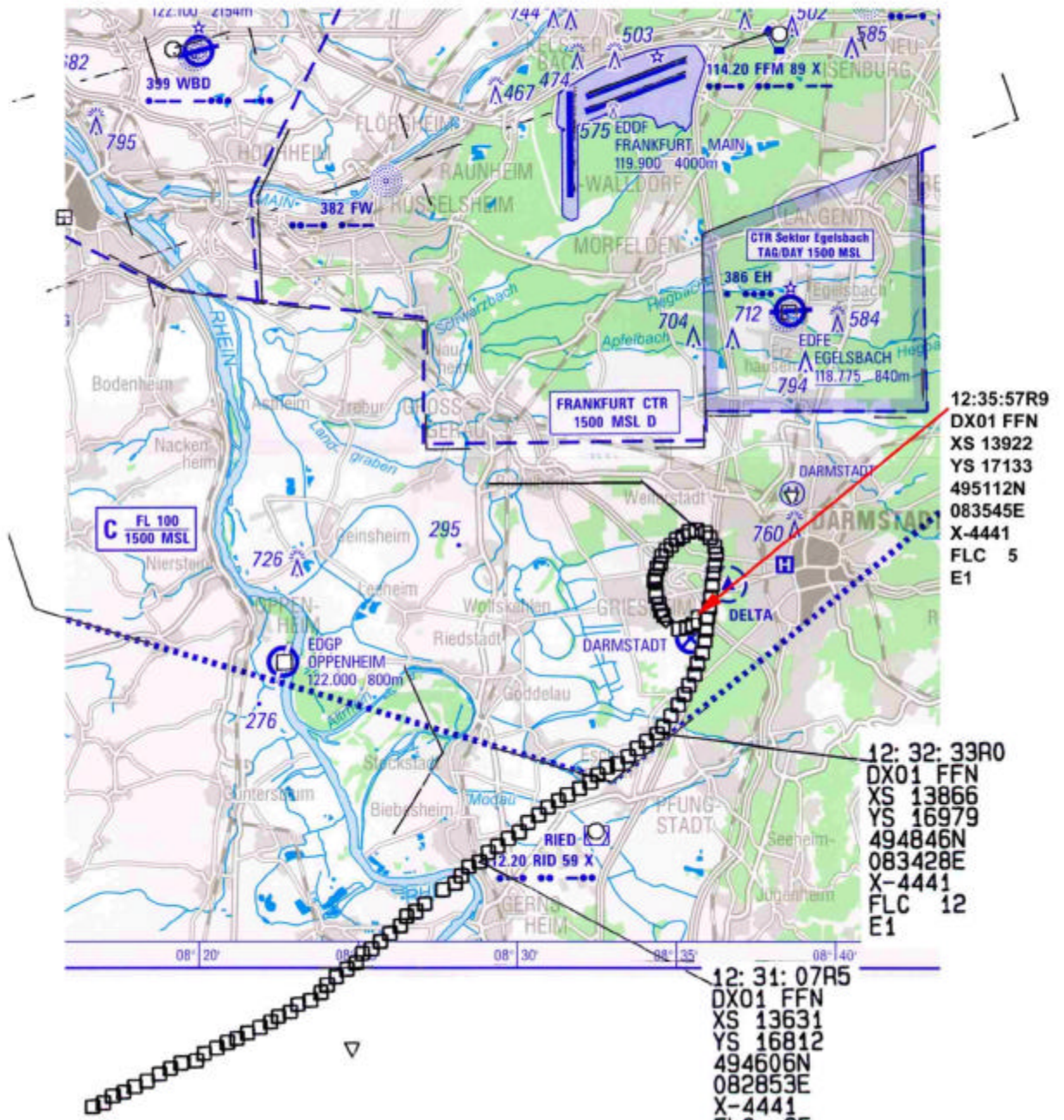




Fuel System schematic of Cessna C 340, with two Auxiliary Tank's and one Wing Locker Fuel Tank on the left side



Evaluation of the radardatas





left main-tank



right main-tank