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# **FINAL REPORT ON THE ACCIDENT TO BRT EIDER (F-PMIC) IN CERFONTAINE ON SEPTEMBER 15 2007**

**Ref. AAIU-2007-14**  
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## FOREWORD

This report is a technical document that reflects the views of the investigation team on the circumstances that led to the accident,

In accordance with Annex 13 of the Convention on International Civil Aviation, it is not the purpose of aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the Final Report is the determination of the causes, and define recommendations in order to prevent future accidents and incidents.

In particular, Article 13 of the Royal Decree of 9 December 1998 stipulates that the safety recommendations made in this report do not constitute any suspicion of guilt or responsibility in the accident.

Unless otherwise indicated, recommendations in this report are addressed to the Regulatory Authorities of the State having responsibility for the matters for which the recommendation is concerned. It is up to those Authorities to decide what action is to be taken.

The investigation was conducted by L. Blendeman, chief investigator.

NOTE: For the purpose of this report, time will be indicated in UTC, unless otherwise specified.

## **Synopsis**

### **Date and hour of the accident**

Saturday, 15 September 2007, around 12.40 UTC.

### **Aircraft**

Type: Barthe Eider  
Registration: F-PMIC

### **Accident Location:**

EBCF - Cerfontaine Airfield

### **Aircraft Owner**

Co-ownership

### **Type of flight**

Local flight

### **Persons on board**

1 Pilot and 1 Passenger-pilot.

### **Abstract.**

The two pilots, one Belgian national, one French national, both with French Private pilot licences, took off from Cerfontaine airfield with the intention of performing a local flight. The aircraft experienced a loss of power immediately after take-off. The aircraft initiated a turn to the left  
The airplane stalled, and crashed.  
The airplane immediately caught fire.  
The two occupants died in the crash.

## **1. Factual Information**

### **1.1. Chronology of the events**

The French-registered aircraft came from the airfield of Corbeny (23km NW of Rheims), and landed at Cerfontaine on the morning of the 15 September 2007, at 08.18 UTC.

The aircraft performed a short local flight of 35min before noon; it was an opportunity for one of the co-owners to fly the aircraft.

The pilot and another pilot took the aircraft after lunch for another local flight. The aircraft did not refuel in Cerfontaine.

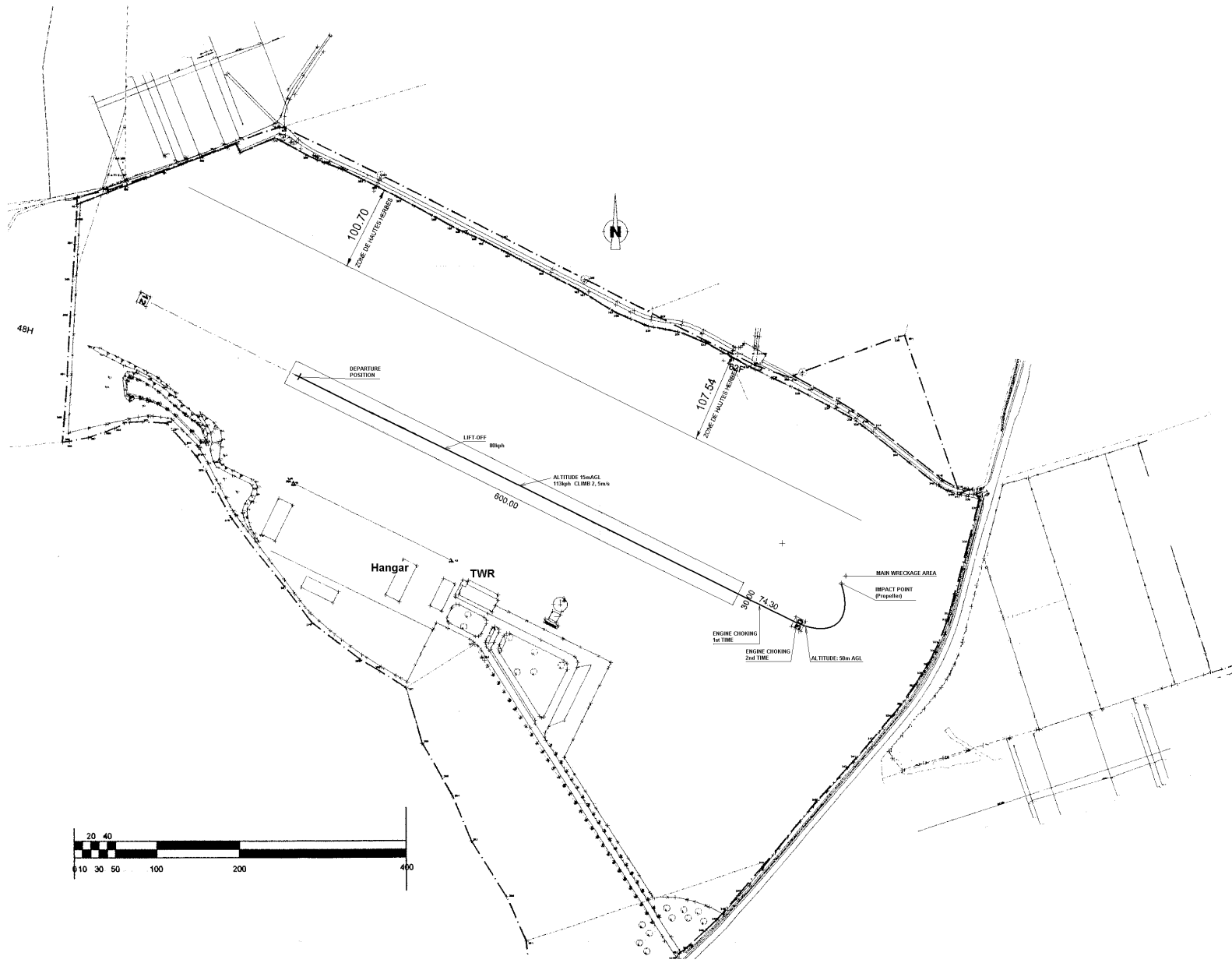
The aircraft taxied for quite a long time, estimated around 15min, and took off from Cerfontaine airfield at 12.40. The aircraft went up to 300ft when the engine coughed and shut down.

The aircraft was then seen turning to the left.

Due to the airspeed and the aircraft attitude, the aircraft stalled and crashed on the left side of runway 12 of Cerfontaine.

The aircraft hit the ground, bounced back and caught fire.

The aircraft was totally destroyed by fire, and the two occupants died in the crash.



### 1.2. Injuries to persons

Injuries	Pilot	Passenger	Others	Total
Fatal	1	1	0	2
Serious	0	0	0	0
Minor	0	0	0	0
None	0	0	0	0
Total	1	1	0	2

### 1.3. Damage to aircraft

The aircraft was totally destroyed by impact and by subsequent fire.





#### **1.4. Other damage**

There was no other damage

#### **1.5. Personnel information**

##### **Pilot (LH Seat).**

Sex: Male

Age: 50 years-old

Nationality: Belgian

Licence: PPL (SEP Land), delivered 11/04/2005 by the French DGAC, valid until 30/04/2009

Medical: Class 2, valid until 31/12/2007

The pilot had a total of 199,15 FH, from which 111,57 as pilot-in-command. He flew the Eider for 18,3 FH in 2007.

##### **Pilot (RH Seat).**

Sex: Male

Age: 61 years-old

Nationality: French

Licence: PPL (SEP Land), delivered 8/12/1975 by the French DGAC, valid until 31/7/2008

Night Flying, delivered 2/2/2004, valid until 31/8/2008

Flight Instructor, delivered 16/5/2001, valid until 31/8/2008

Medical: unknown.

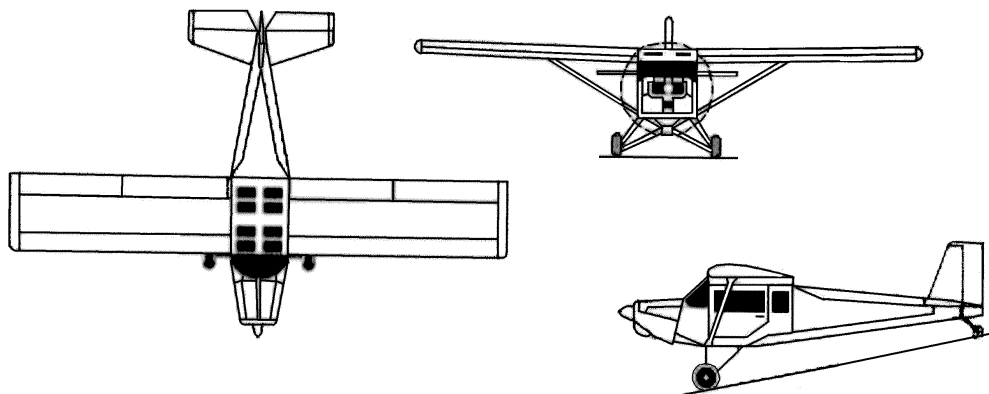
The pilot had a total of more than 6660 FH, from which more than 6410 FH as pilot-in-command.

He flew the Eider for 9,2 FH in 2007.

### 1.6. Aircraft information

The aircraft is an home-built aircraft based on the construction kit for the Murphy Rebel aircraft and featuring several important changes. These changes led to a change of aircraft designation.

The Manufacturer is Barthe Michel, the aircraft is designated BRT Eider.



3-view of the BRT Eider.

**Murphy Rebel**

The Murphy Rebel is all-metallic with fabric-covered flight control surfaces, high wing, conventional landing gear. It is certified to comply with FAR 23 Part C, BCAR Section S and Canadian TP10141E standards.

The Murphy Rebel holds a good safety record.

The US NTSB reports 8 accidents involving the Murphy Rebel over a 20-years period. All accidents were non-fatal. The identified causes were all operational. The FAA registry identifies over 140 Murphy Rebel.

The Canadian registry identifies 138 Murphy Rebel, and the TSB lists no accident with this type of aircraft.

In France, the BEA records 3 non-fatal accidents for which the causes were also operation-related.

**BRT Eider**

**Airframe**

Manufacturer: Michel Barthe / Murphy Aircraft Mfg, Ltd  
Type: BRT Eider  
Serial Number: 1  
Built year: 1993  
Registration: F-PMIC  
Certificate of Registration: B23257, issued 5/6/2006 (change of ownership)  
Certificate of Airworthiness: CNRA (Certificat de Navigabilité Restreint d'Aéronef) N°271963, based on File Nr 3734-1.  
Airworthiness Inspection: Performed on 14/4/2005, valid until 14/4/2008.  
Total Flight Hours: 242 FH.  
TSO: 122,3 FH

**Specifications:**

	BRT Eider
MTOW (kg)	748
Empty Weight (kg)	470,6
G-Loading (normal)	+5.7 -3.8
Wing Span (m)	9,2
Wing area (m2)	12,2
Length (m)	6,6
Fuel Quantity (l)	180 (167L usable in level flight)

F-PMIC was involved in an accident on 31 October 1998 on the La Mure high-altitude airfield, where the aircraft made a hard landing.

Additional modifications were brought in 2002 and concerned a general reinforcement of the forward structure due to the installation of a new engine, and included the following:

Fuel Tanks: Fuel feed in 2 point (Fwd and Aft) on each tank.  
Installation of an electric pump.

Landing Gear: Modified in "Piper-style" with sandows and reinforced tubes.  
Installation of a MATCO tail wheel.

Fire protection: 1 cut-off valve (ON/OFF) for each tank.

Safety Belts: 3-points belts on each seat.

Engine: Avco Lycoming 0-320 installed.

Exhaust: Exhaust from DR400 installed.

Propeller: LEGER propeller installed.

### Engine

Manufacturer: AVCO Lycoming  
Type: 0-320-A2A  
Serial: L920227  
Power: 150 HP / 112kW  
Total Flight Hours: 2649.3 FH  
TSO: 122,3 FH

### Propeller

Manufacturer: Léger  
Type: AL 1659  
Serial: N°5  
Total Flight Hours: 122,3 FH

### Maintenance

The maintenance programme was approved by GSAC, and features the following inspection intervals:

	Last Performed		Next check due
	Date	Counter (airframe)	
50 FH	7 July 2007	234,3 FH	294,3 FH (afm)
100 FH	7 July 2007	234,3 FH	334,3 FH (afm)
Annual check (*)	10 June 2006	163,1 FH	13 July 2007
Overhaul (500 FH / 3 years) (**)	23 Feb 2005	120 FH	23 Feb 2008 500 FH (afm)

(\*) tolerance of +/- 1 month

(\*\*) tolerance of +/- 3 months or 50FH wof – provided performance of 100 FH check.

Note: a discrepancy is noticed on the annual check: in the ATL , the 100 FH/ annual check is signed off on 10 June 2006, with a subsequent due date of 10 June 2007; one month later, on 13 July 2006, a 50 FH inspection is entered in the ATL, and the due date for the 100 FH/ Annual due date is changed into "13 July 2007".

**Owner**

Co-ownership with Pilot (Left Seat), Mr Coene André and the manufacturer, Mr Barthe Michel.

**1.7. Meteorological information**

Observed at EBFN - Florennes military Airport

**At 12.25**

Wind:

Direction: 130°

Speed: 5 kts

Visibility: more than 10 km

Clouds: no clouds

Pressure: 1024 hPa

Temperature: 18°C

**At 13.25**

Wind:

Direction: Variable

Speed: 2 kts

Visibility: more than 10 km

Clouds: Few at 4200 ft

Pressure: 1024 hPa

Temperature: 18°C

The meteorological conditions have had no impact on the event.

**1.8. Aids to Navigation**

None, although the aircraft is believed to have been equipped with a GPS.

**1.9. Communication**

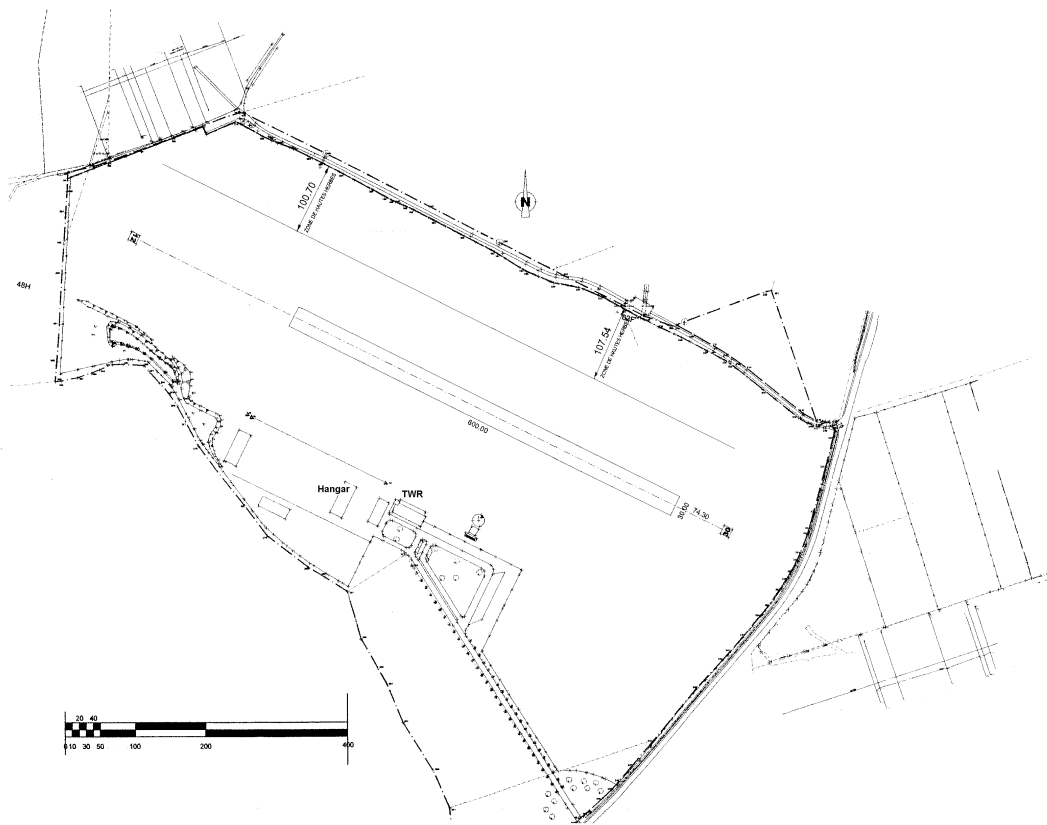
Not relevant.

**1.10. Airport information**

The aircraft had taken off from EBCF - Cerfontaine airfield.

ARP COORD and site:	500910N - 0042314E
ELEVATION (ft)	955 ft

RWY designator	TRUE BRG	Dimensions of RWY (m)	Slope	Strenght	Surface
12	117°	630 x 30	nil	5700 kg	grass
30	297°	630 x 30	Nil	5700 kg	grass



EBCF – Cerfontaine airfield

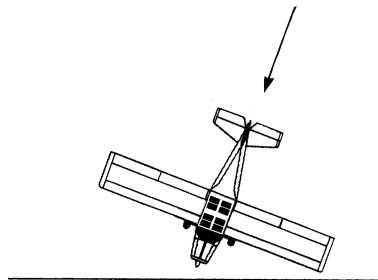
### 1.11. Flight Recorders

Not applicable.

### 1.12. Wreckage and Impact information

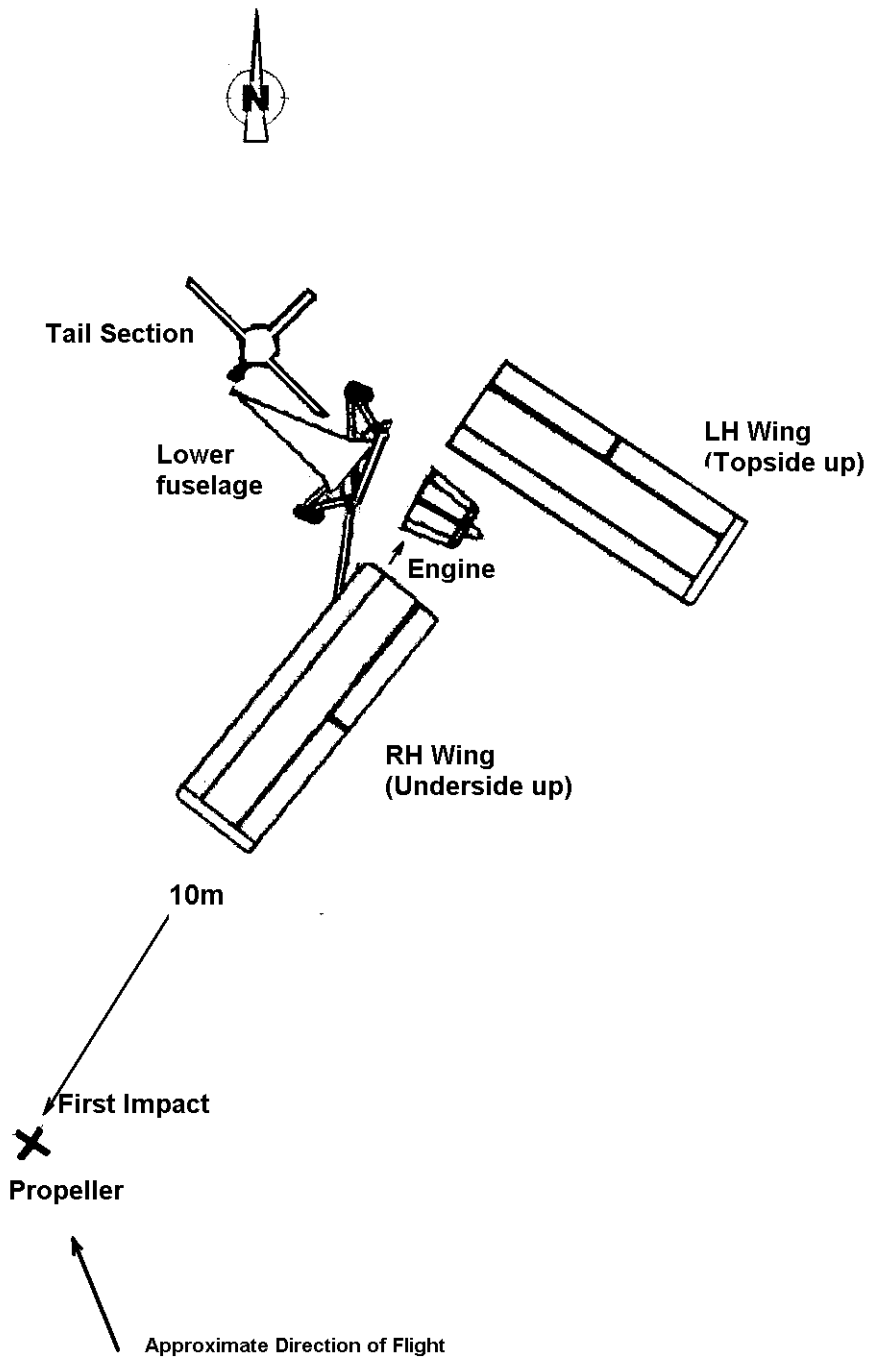
The aircraft crashed 105m behind the end of Runway, 50m North of the Runway axis.

The aircraft impacted the ground with a slight angle, the left wing contacted the ground together with the engine. The engine took the first shock.



The aircraft bounced and rotated to the right, and the wings separated; the left wing separated upon the first impact, while the right wing remained attached until the fire broke out. The rotation to the right might have come from an initial movement of the aircraft, combined with the impact of the left wing with the ground.

The first impact, where the propeller was found, is 10m away from the final resting place.



Final resting place of F-PMIC (view from the top)



The blades of the propeller were found together, buried in the ground, confirming that the engine did not deliver high power when the aircraft hit the ground.



The two wings are separated from the fuselage. The RH wing is burned on 1/3 of its length, near to the fuselage. The LH wing is totally burned.

The tail section is separated from the rest of the fuselage. It did not burn, and is only connected to the rest of the wreckage by the control cables.

The flap and aileron control rods melted due to the intense post-crash fire.

#### **1.13. Medical and Pathological information**

It is impossible to determine whether the pilot and passenger died from the shock of the impact of the aircraft with the ground, or by the subsequent fire.

#### **1.14. Fire**

Fire broke out shortly after impact. The fuel tanks ruptured by the shock, and fuel came in contact with the hot parts of the engine, causing vaporization. The ignition came probably by electrical sparks from the damaged electrical system.

**1.15. Survival Aspects**

The two pilots were attached with safety belts. The cabin structure was completely destroyed.

The structure of the aircraft is light, and therefore has little resistance to a frontal shock.

**1.16. Test and Research**

The wreckage was examined, and the engine was sent for dismantling and further investigation in a repair station. For details, see chapter 2.

## 2. Analysis.

### 2.1. General.

The Murphy Rebel type of aircraft experienced some problems of fuel starvation. Murphy issued 3 Bulletins;

- Construction Bulletin 100594RB-1, recommending
  - o To use 3/8" fuel shut-off valves instead of the original 3/16" valves, and
  - o The installation of a cross-vent.
- Safety Bulletin 070395RB, recommending
  - o Modification of the fuel sight gauge, and
  - o To avoid flying with very low fuel levels (not further defined)
- Builders notice 012893RB, recommending to enlarge the venting hole in the venting gas caps.

The fuel system of F-PMIC incorporated some of the above-mentioned modifications; a cross-vent was installed.

Nevertheless, this aircraft (F-PMIC) experienced fuel feed problems in several occasions;

- In Toulouse Labordes (17.06.06) – fuel feed problem during take-off and taxi.
- In Corbeny, during take-off
- In Prunay and Gueret, during taxi.

These problems were encountered with a remaining fuel quantity of 20 / 30 L.

A witness recalls seeing the aircraft during take-off, one or two months before the crash, having engine problem. The engine made a loud bang at aircraft rotation.

Owing to the rear fuel connection in the tank not being located at the extreme rear of the tank (2/5 of the width of the wing), with nose up attitude (as typical during aircraft rotation), the engine may experience fuel starvation with a low quantity of fuel in the tanks.

The owner defined a solution for this problem, but this modification was not submitted for approval to DGAC, and therefore not yet applied. The solution involved the installation of an additional feeder tank of 5-10L capacity inside the cabin, between the wing tanks and the fuel filter.

### 2.2. Fuelling

The aircraft was not re-fuelled in Cerfontaine. However, witnesses confirm that the RH fuel tank was ½ full and the LH tank was ¼ full at the start of the flight preceding the accident.

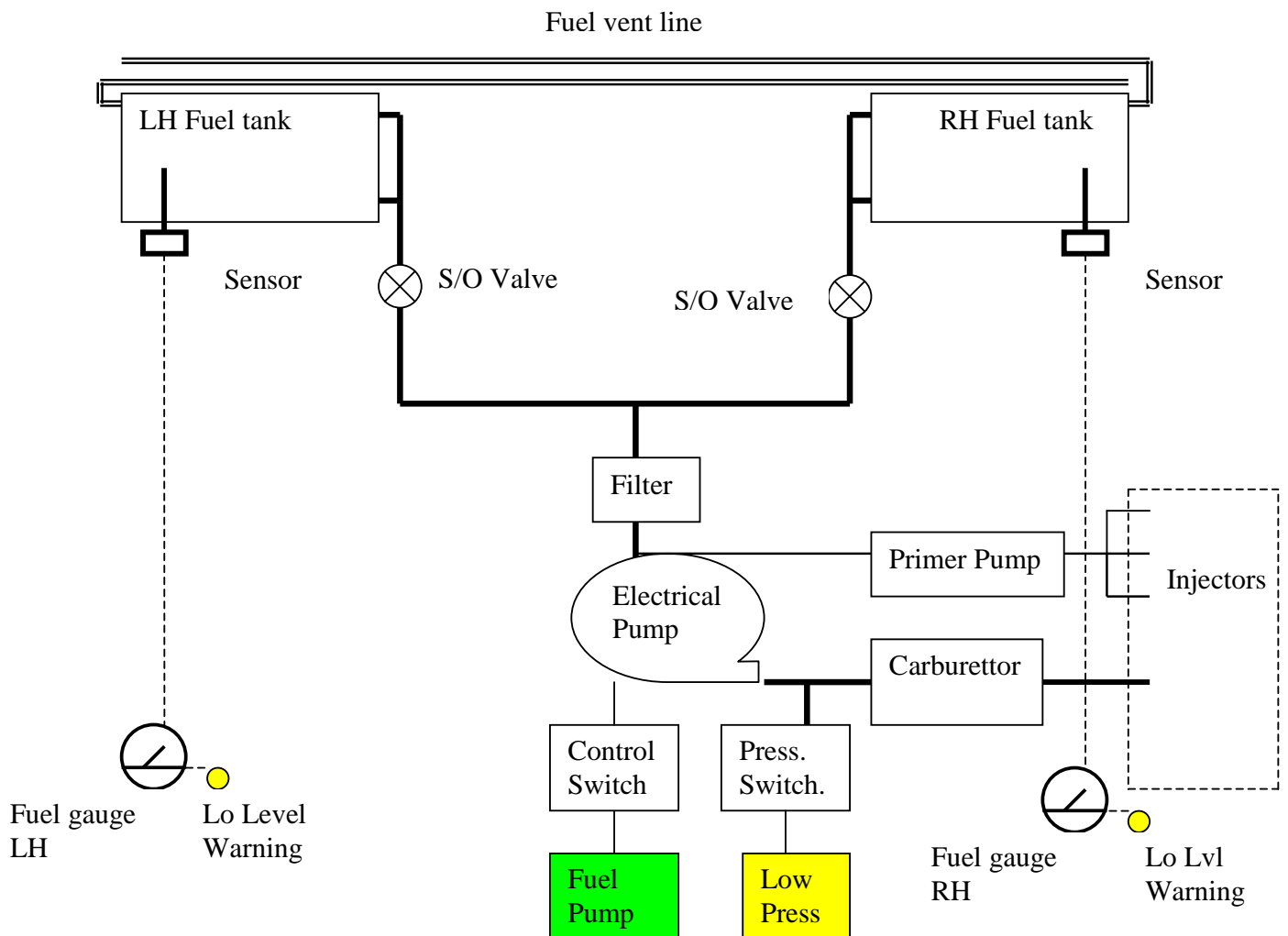
This means that there were 60 to 70 liters of fuel remaining in the tanks upon take-off. The fire that broke out after impact confirms also that there were plenty of fuel on board.

### 2.3. Fuel System.

In respect to the original drawings of the Murphy Rebel, the fuel system of the BRT Eider was reviewed and modified.

The main changes were:

- removal of the fuel tank selector switch.
- Installation of 2 manual shut-off valves
- Replacement of fuel lines by flexible Aeroquip 491-6 hose.
- Installation of an electrical fuel pump between the fuel filter and the carburetor – because of the lack of mechanical fuel pump on the 0-320 engine. The pump is controlled by a switch in the control panel, and has a condition (on/off) light.
- Installation of a second connection in each fuel tank. Each tank has a front and a rear connection.
- The fuel lines are installed behind the firewall and connected to the Fuel filter inside the engine compartment.
- The primer fuel pump is connected to the fuel injectors.
- A fuel gauge is installed for each tank, with a low level warning light.
- A fuel pressure warning light is installed on the control panel.



a. **Fuel shut-off valves**

The 2 fuel valves were found in the closed position, in the wreckage:



The positioning of the valves led to an hypothesis; i.e. that they were closed during the Take-off, and that it was the origin of the shut-down of the engine.

Tests were conducted with similar aircraft, equipped with the same type of engine.

In particular, a test with a PA-18 Super Cub, with fuel line pinched at the approximate location of the valves, showed that the engine could operate at full power for 9secs. The configuration of the fuel system of the Eider could increase this time to 12 secs. Considering the power of the engine and characteristics of the aircraft, this time could be consistent with the events occurred to the F-PMIC.

However, witnesses told that the aircraft taxied and held position, with engine turning for a considerable amount of time; believed to be about 15min.

The fuel pipes were attached to the walls of the cabin, and it is suspected that these pipes were displaced during removal of the bodies.

The Flight manual indicates that in case of engine problems at take-off the 2 fuel shut-off valves must be closed.

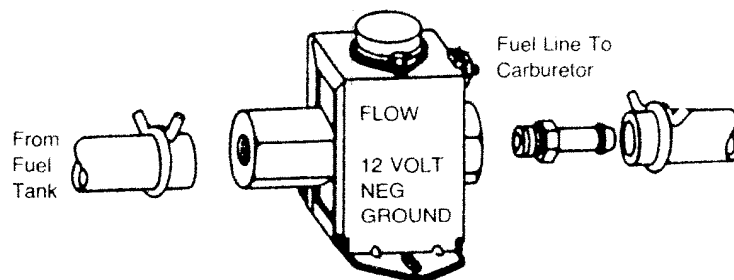
The closed position of the shut-off valves in the wreckage could either come from the action of the pilots, before take-off, or after the engine shut-down in accordance with the Flight manual, or by the action of the fire brigade when removing the bodies. We cannot therefore conclude that this position is indicative of their actual position during flight.

**b. Fuel Pump.**

The pump was heavily damaged during the crash, and the inner elements were melted; it was therefore impossible to determine whether the pump was operating or not.

**Installation**

There was no mechanical fuel pump installed on the engine. Instead, an electrical pump was installed, between the fuel filter and the carburetor. The pump is a Facet Cube Solid State Fuel pump p/n 40108, used mostly in automotive applications.



The pump was installed inside the engine compartment, on the Left side of the fire wall.

The pump was not fitted with a by-pass valve but by construction, the pump would not have blocked the flow (pressure drop is believed to be “less than 1 psi” at take-off rating).

**Trouble history**

During the last maintenance check, a check was performed on the fuel pump “to detect a possible malfunction”. The check concluded there was no apparent failure.

The maintenance file shows no recordings of fuel flow, nor pressure measurement. However the file records that the “Fuel Low Pressure” alarm was continuously “ON”. After the test, this warning was considered false, and the warning light masked by tape.

The pressure switch is manufactured by Jaeger (p/n 521157000), for installation on Robin aircraft; the working pressures are 0,6 – 0,9 psi.

**Hypothesis 1 – Pump Failure**

In case of pump failure, the engine would be fed by gravity, thanks to the difference of height between the fuel tank and the carburetor, through the fuel filter and the pump. The pressure at the carburetor would have been 1,6 psi maximum (pressure drops through filter and pump not accounted). The actual pressure is believed to be around 1 psi.

It is possible that the fuel pump failed during taxi or take-off, and that the flow delivered by gravity was not sufficient to feed the engine at take-off rating, causing the shut down. The nose-up attitude of the aircraft has also a

negative impact on the fuel pressure, by reducing the height between fuel tank and carburetor.

The pump inner elements could also have caused a restriction in the line and turbulent flow as a consequence, due to a venturi effect. This can cause bubbling of the fuel and possible interruption of the flow.

**Hypothesis 2 – Vapor Lock.**

Another phenomenon that could have caused the engine shut down is vapor lock.

The fuel filter and the fuel pump were installed inside the engine compartment on the left side of the fire wall.

The aircraft performed a flight before noon, and was left for a couple of hours outside during lunch time.

The weather was good, but not excessively warm; the ambient temperature was around 19°C, and the sky partly cloudy.

The fuel on board was Avgas 100LL.

Prior to take-off, the aircraft was kept on the taxiway for 10-15 minutes, waiting for inbound traffic. The engine was running at idle.

The ventilation inside the engine compartment must therefore have been minimal, and the temperature abnormally high.

It is believed that under these conditions, the temperature of the fuel inside the engine compartment could have reached a critical value, with vapor lock as a consequence, and subsequent engine shut-down.

**c. Fuel venting.**

Plugged fuel vent may create a vacuum in the fuel tank, and starvation as a consequence.

The fuel vent system was checked; but it was only visible in the RH wing (LH Fuel tank vent); the LH wing was severely damaged by fire, and all traces of the vent tube were gone. The remaining tube (1m) was not obstructed.

There was an additional venting through the fuel caps.

There is no indication that could incriminate the venting system as a possible cause.

**d. Air suction.**

A last possibility, is that air could have been sucked through a hole in the fuelling lines. This is known to cause air bubbles in the fuel lines, and fuel starvation as a consequence.

However, the state of the fuel lines did not allow to confirm this hypothesis.

#### 2.4. Engine.

The engine was inspected on-site, and subsequently sent to a repair station for further analysis.

The on-site inspection was basically an external visual check of the condition of the engine, its accessories and spark plugs. The engine was found rotating.

Further to that inspection, the engine was sent for dismantling and inspection of the internal parts.



Factors that could have resulted in a loss of power of engine:

1. Poor combustion.

The compression of the cylinders was checked on 7 July 2007 and was found within acceptable limits. The compression could not be verified on the engine after the fire, since the valve springs have been overheated, and the spring rate was altered.

It is assumed that the compression ratio was correct.

2. Leaks in induction system.

Induction leaks cause poor idle and/or poor engine acceleration.

The induction hose was checked, and no obvious defect was detected.



3. Improper fuel flow.  
The carburettor was destroyed, but the spark plugs showed a normal color (chocolate brown), and the aircraft flew twice during that day.



4. Restriction in air inlet or manifold.  
The air inlet was crushed by impact force, so was the carburettor. However, owing to the configuration of the air inlet, it is improbable that the air inlet would become obstructed, so that the engine would shut down; also, there were no sign of abnormal combustion reported by the witnesses (black smoke).
5. Alternate air door leaking allowing heated air to enter carburetor.  
The air inlet was crushed by impact force, so was the carburettor, but this would not cause the engine to stop abruptly.
6. Throttle lever not properly adjusted.  
The throttle lever was found, but did not show signs of separation.



**throttle ctl**

7. Carburetor ice.  
Not likely, due to the atmospheric conditions; 19°C .
  
8. Worn out spark plugs.  
This would only cause a reduction in power, but the spark plugs were found in good condition.



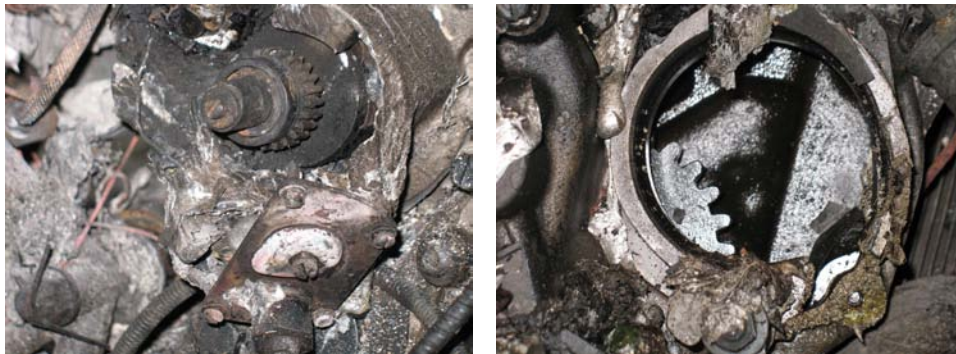
9. Air filter dislodged and stuck in intake system thereby cutting off the air supply.  
As the air inlet is crushed by impact force, this was impossible to determine.



10. Carburetor heat flapper valve in the air box partly open  
As the air inlet is crushed by impact force, this was impossible to determine.



11. Magneto problem.  
Both magnetos were severely damaged; the RH magneto was ripped off, and the LH melted down, making any determination impossible; it is however believed that the simultaneous failure of both magnetos is improbable.

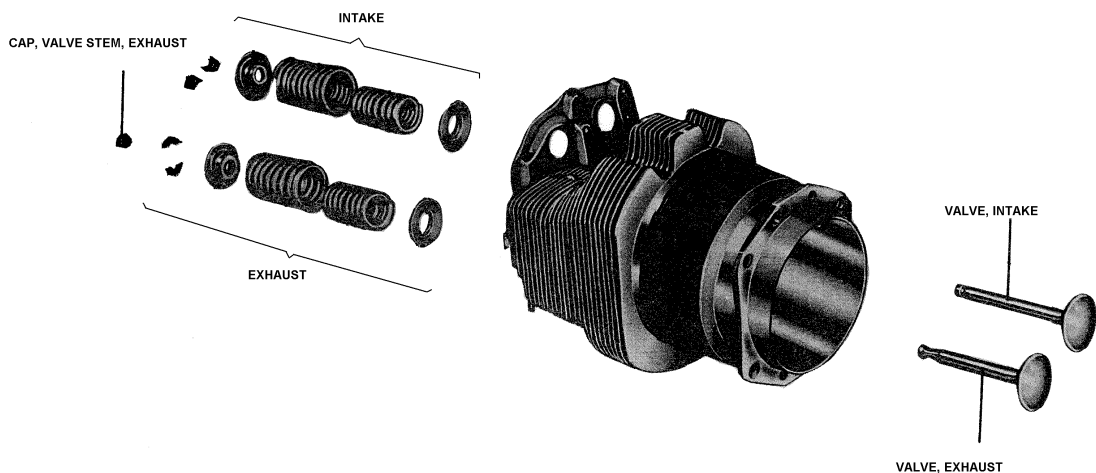


12. Dirty or restriction in fuel nozzle.  
This would be accompanied by oily spark plug, and they did not show such phenomenon.
13. Carburetor blockage in the channel at the base of the mixture metering sleeve where fuel pick-up occurs for the fuel discharge nozzle.  
This would cause the float to be unusually high. As the carburetor is destroyed, this hypothesis cannot be verified.

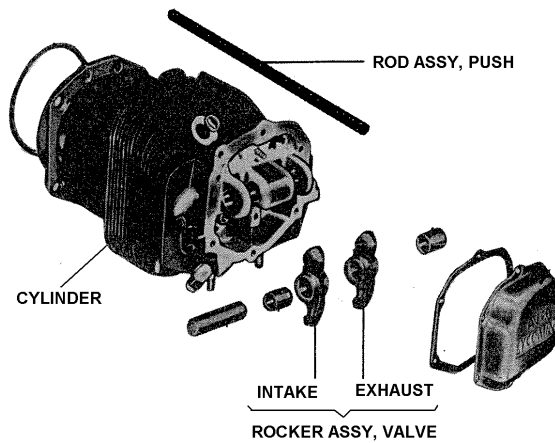
14. Failure of the mechanical (diaphragm style) fuel pump.  
The engine of F-PMIC was not equipped with a mechanical pump.
15. Water ingestion into engine. Water trapped in integral wing tank.  
Not likely, since the aircraft flew twice the same day, without re-fuelling
16. Loose carburetor bowl attachment bolts allowing air to suck into carburetor  
The carburetor is heavily damaged, however, the fixation bolts to the engine were checked, and no anomaly found.  
This specific item was checked on 7 July, during maintenance.
17. Weak or broken carburettor valve spring  
As the carburettor is heavily damaged, this could not be verified.
18. Internal failure of the engine:
  - i. Mechanical failure of camshaft,  
The engine was dismantled and the camshaft inspected; no anomaly was found.
  - ii. Mechanical failure of valves.  
No failure were found.

During disassembly, NO discrepancies were found that could have be related to the crash and subsequent fire; nevertheless, a few findings were made:

- The Cap, Valve stem, exhaust was missing on all 4 exhaust valves. This gap was not compensated by longer push rods (rod assy, push), since all four were found of the same length.



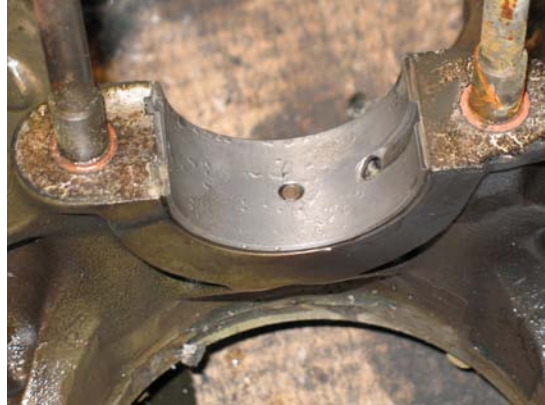
- The rocker assembly is different for the intake and the exhaust; the difference lies in cooling hole on the exhaust valve rocker. On the engine, the parts were found mixed (exhaust on intake position, and vice-versa).



- On 2 cylinders, fixation bolts to the through-studs were found missing. These bolts are part of the fixation of the cylinders onto the engine.



- The crank shaft and the bearings showed abnormal wear, possibly fretting due to the incorrect fixation of cylinders.



These anomalies would have induced abnormal wear of the engine, and possibly future problems, but are not the cause of the engine shut-down that led to the crash of F-PMIC.

## **2.5. Maintenance.**

### **a. General.**

The Maintenance programme of F-PMIC is based upon the maintenance programme of Murphy, and approved by GSAC (14 April 2005).

The cycle of inspection is as follows:

- i. 50 FH inspection.
- ii. 100 FH inspection (actually identical to the 50 FH inspection, with 1 item added).
- iii. 500 FH / 3 years, identical to the 100 FH inspection, but requiring the removal of wings, ailerons, and stabilizers for a deep visual inspection of the attachments points.

As stated before, the maintenance programme was complied with within the stated tolerance.

### **b. Last maintenance performed.**

The last inspection was performed on 7 July 2007. The routine works were performed, as well as additional works (installation of an EFIS)

With respect to the engine and fuel system, the following tasks were performed:

- replacement of the RH Fuel Tank drain valve.
- Measurement of the fuel quantity in the tanks, and the corresponding indication in the cockpit (flight and ground attitude).
- Verification of the electrical fuel pump for a suspected malfunction (see chap 2.2.b. above).
- Replacement of the Low Oil Pressure switch.

There were a series of defects the correction of which was deferred, some of them were deferred from previous maintenance checks (more than a year old). Among the many, were important items related to the fuel system:

- Recurrent problems of fuel starvation during take-off and taxi (see chapter 2.1.), for which a solution was defined, but not applied.
- Installation of new fuel caps.
- Installation of a new –more sensitive- fuel pressure switch (which raises question with respect to the fuel pump trouble-shooting).
- Repair of the LH Tank fuel quantity indicator (oscillations).

During the maintenance checks, there was clearly an opportunity to correct the fuel feed anomalies that were detected in operation.

## **2.6. The flight.**

The take-off itself was normal. When the aircraft reached an altitude of 300 ft, the engine coughed once, then coughed again, and the engine stopped.

According to a witness, the aircraft leveled then steered to the left, starting by a flat turn, as if the pilot would have turned with the rudder, instead of the aileron; it was only then that the aircraft dived.

This could have been a stall followed by an incipient spin to the left, inducing a rotation movement. This could explain the left rotation movement upon impact as described above.

It is difficult to determine the pilot's intention upon the engine failure. The flight manual (and pilot's good sense) states that in such case, the aircraft must be flown straight ahead with minimal (+/- 30°) deviation and an emergency landing must be attempted.

In a straight line, in Cerfontaine, the distance between the end of the Runway and the tree line of the woods is quite short. However, with a small turn (20 to 30°), an emergency landing was possible in a field (800m).

Nevertheless this option was not taken by the pilot; either he decided to perform a 180° (rather 270°) turn to go back to the airfield, or he was surprised by a too low speed that led to a stall.



### **3. Conclusions.**

#### **3.1. Findings**

- Both occupants had a valid Pilot's licence and medical certificate. One of the occupants (RH seat) has considerable flight experience and an instructor's licence.
- The aircraft had a valid airworthiness certificate and was maintained in accordance with the manufacturer's maintenance program.
- The aircraft experienced engine troubles at take-off in the past.
- Trouble-shooting to determine the cause of the engine troubles at take-off was still in progress. Defined solutions were not yet applied.
- The aircraft fuel tanks contained sufficient fuel.
- The analysis of the remains of the engine highlighted some anomalies, but these were not of the nature to cause the engine shut-down.

#### **3.2. Causes.**

No cause was positively identified to explain the engine failure.

- After engine shutdown, the aircraft veered to the left, and stalled, causing the crash.
- Fuel feed problems were known for a considerable amount of time. The trouble-shooting that was performed was not concluded by the application of a definitive corrective action. The aircraft continued to be flown in spite of the remaining threat.
- The analysis of the aircraft file, and the remains led to the following hypothesis for the accident:

##### **Hypothesis 1.**

The electrical fuel pump failed, and the engine was fed by gravity. Due to the pressure losses through the filters and pump, the fuel flow became insufficient for the commanded take-off rating, and the engine coughed, and shut down.

##### **Hypothesis 2.**

The engine ran for a considerable amount of time in idle. The engine compartment became overheated, and the fuel temperature in the pump reached a critical level, causing vaporization, and the engine stalled due to vapor lock.

**4. Safety recommendations.**

**4.1. To BEA / DGAC– (Pilot - owners)/ BCAA (Pilot – owners)**

Troubles related to engine problems at take-off were known on this aircraft for a period of time. These problems never led to an engine shut-down, such as experienced during the accident, but – seen after the events – they were probably indicative of a weakness in the fuel system.

Accidents such as this may be used as example for all pilots that the correct reporting of all small anomalies occurring during flight is important to understand and recognize a growing problem.

Also, especially for all pilots performing maintenance on their own aircraft, the correction of defects may not be deferred indefinitely, and if a problem seems unsolvable, that expert advice must be seek with experienced mechanics.

We recommend DGAC / BCAA to remind all pilots of the basics of trouble reports, in the style of what is used in Commercial Air Transport (report issued by the pilot and countersigned by maintenance, with a system of controlled deferred maintenance action), and sound aircraft maintenance management.

**4.2. To DGAC– (Pilots)/ BCAA (Pilot – owners)**

Stall/spin at low altitude accidents tend to be more deadly than other types of accidents occurring in General Aviation. In the last 10 years in Belgium, 30 percent of the mortal accidents in fixed-wing, general aviation-type of aircraft were due to stall / spin at low altitude. Common cases encountered ranged from freshly certified pilots wanting to show relatives their piloting skills, to experienced pilot wanting to land their airplane having experienced an engine failure shortly after take-off.

A sensibilization campaign by DGAC / BCAA towards pilots is recommended, in order to identify the dangers of stall / spin at low altitude.

About turning back after engine failure during take-off phase of flight of a single engine aircraft, a recommended document is “the possible ‘impossible’ turn of Mr David F. Rogers.