

**FINAL REPORT ON THE ACCIDENT  
TO B&F TECHNIK FK 14B POLARIS  
REGISTERED OO-G15 AT NIVELLES  
ON 25 JULY 2010**

FOREWORD.....	3
SYNOPSIS .....	4
1. FACTUAL INFORMATION.....	6
1.1. History of flight.....	6
1.2. Injuries persons.....	7
1.3. Damage to aircraft.....	7
1.4. Other damage.....	7
1.5. Personnel information.....	7
1.6. Aircraft information.....	9
1.7. Meteorological conditions (At EBCI Airport).....	14
1.8. Aids to navigation.....	14
1.9. Communication.....	14
1.10. Aerodrome information.....	14
1.11. Flight recorders.....	15
1.12. Wreckage and impact information.....	17
1.13. Medical and pathological information.....	20
1.14. Fire.....	20
1.15. Survival aspects.....	20
1.16. Tests and research.....	21
1.17. Organizational and management information.....	21
1.18. Additional information.....	21
1.19. Useful or effective investigation techniques.....	21
2. ANALYSIS.....	22
2.1. Flight path.....	22
2.2. Altitude analysis.....	23
2.3. The loss of control.....	23
2.4. Wreckage examination.....	25
2.5. Weight & Balance.....	26
2.6. The Emergency Parachute Recovery System.....	28
2.7. The safety belts and shoulder harness cables.....	29
2.8. The Flight Manuals.....	30
2.9. Pilot License.....	31
3. CONCLUSIONS.....	32
3.1. Findings.....	32
3.2. Causes.....	32
4. SAFETY RECOMMENDATIONS.....	33
4.1. Recommendation 2011-U-9 to the Belgian ULM Federation.....	33
4.2. Recommendation 2011-U-10 to the Belgian CAA.....	33
4.3. Recommendation 2011-U-11 to B&F TECHNIK.....	33
4.4. Recommendation 2011-U-12 to B&F TECHNIK.....	33

## **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 16 of the EU regulation EU 996/2010 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 with which the recommendation is concerned. It is for those Authorities to decide what action is taken.

The investigation was conducted by H. Metillon.  
The report was approved by L. Blendeman.

### **NOTE:**

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

## SYNOPSIS



### **Date of the accident**

25 July 2010 at 14:40 UTC

### **Aircraft**

B&F TECHNIK FK 14B Polaris

### **Accident location**

The accident occurred in a field between the cities of Nivelles and Genappe.  
(N50° 35.625' E04 23.751)

Elevation: about 500ft

Airspace status: Class G, below EBCI TMA (TMA: 2500ft =>4500ft)

### **Aircraft owner**

CONFLUENCE S.C.R.L.

### **Type of flight**

Private

### **Persons on board**

Two

## **Abstract**

On Sunday 25 July 2010, the pilot decided to perform a local flight from the ULM Airfield of Buzet.

He contacted "Confluence" to hire an airplane and went to the airfield around 14:00 UTC.

On his arrival to the airfield, the pilot met the passenger and they decided to make a flight together.

After some checking they took off with the ULM airplane B&F TECHNIK FK 14B Polaris registered OO-G15.

At about 14:40 UTC a few witnesses, who were some way from the crash site, saw the aircraft going down, in a spin.

The airplane crashed in a field at 5,8 km north of the airfield of Buzet. The witnesses immediately called the rescue services.

The two occupants were killed upon impact.

## **1. Factual information.**

### **1.1. History of flight.**

On Sunday 25 July 2010, the pilot decided to perform a flight from the ULM Airfield of Buzet.

The pilot was practicing familiarization flights with the Polaris FK 14. He had already performed several flights beginning on 18 June 2009 under the supervision of an instructor.

He wanted to perform a local flight with a Polaris FK14 aircraft and contacted "Confluence" to hire an airplane.

At his arrival in Buzet around 14:00 UTC he met a friend and they decided to make a flight together. This person was also a pilot having himself performed some familiarization flights with the Polaris. He will be identified in this report as the second pilot.

After the flight preparation the airplane took off and flew to a practice area.

At about 14:40 UTC a few witnesses, who were some way from the crash site, saw the airplane going down in a spin and /or heard a detonation.

One of these witnesses specified that he first saw the airplane flying during a short period of time in a horizontal attitude. Then the airplane suddenly fell down before entering into a left hand spin.

Another witness only heard a detonation and saw a parachute opening at ground level. The parachute remained opened for at least five minutes in the same place.

No reliable information about the altitude of the airplane was reported by the witnesses.

The airplane crashed in a field at 5,8 km north of the airfield of Buzet.

The witnesses immediately called the rescue services.

The airplane wreckage was found 10 minutes later by the police and some of the witnesses.

Later another witness reported having seen a yellow airplane making unconventional manoeuvres at the time and place of the accident.

## 1.2. Injuries persons.

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

## 1.3. Damage to aircraft.

The airplane was destroyed upon impact

## 1.4. Other damage.

The ground was slight polluted by fuel.

## 1.5. Personnel information.

### First Pilot

Sex: Male

Age: 44 years old

Nationality: German

Licenses: Belgian Glider Pilot's Licence delivered by the "Royal Belgian Aeroclub" on June 24, 2009. (First delivered on 12 August 2002).  
Belgian Aircraft Training License delivered on 18 December 2003, valid till 19 November 2005 (As per medical certificate).  
French ULM license delivered on 21 August 2009.  
Belgian ULM Training License delivered on 15 June 2009.

Medical: Last medical certificate delivered on 09 June 2009.  
Valid till 6 June 2011

Experience: The Pilot's Logbook and the OO-G15 Aircraft logbook show the following experience starting June 18, 2009:

- Total Time on ULM Airplanes: 28:21 from which 10:35 as pilot in command
- Total time on B&F TECHNIK FK 14B Polaris: 17:18 from which 7:35 as Pilot in command.

This Pilot's Logbook doesn't show:

- His previous experience gained as a student on Single Engine Aircraft from 18 December 2003. (Reportedly this experience was around 15 FH)
- The glider flight experience (Reportedly this experience should be at least around 470 FH).
- The ULM flight experience gained as a student on French registered ULM before 18 June 2009.

The last flight was performed on B&F TECHNIK FK 14B Polaris on 11 July 2010.

Most of the flights recorded in the Pilot Logbook were local flights from EBBZ and LFNS performed on FK 9, FK 14 and "Rans Coyotte" aircraft.

#### **Second Pilot**

Sex: Male

Age: 52 years old

Nationality: Belgian

Licenses: French ULM license delivered on 13 April 2004 for ULM "Multiaxe" and on 2 January 2006 for ULM "Pendulaire".

Belgian ULM License delivered early 1980, no longer valid.

Experience The passenger was known to be one of the first Belgian ULM pilots and ULM instructor (Moniteur). He stopped flying from 1986 to 2003. Reportedly, he had accumulated at the date of the accident more than 5000 flight hours experience as ULM pilot from which 1500 flight hours were since 2004. His flight experience during the last years consisted essentially of navigation flights on a French registered "Rans Coyotte" ULM. Reportedly he made from time to time a flight as passenger in a Polaris for a total of five flights. The Pilot's Logbook was not available to support the above information.



## 1.6. Aircraft information.

The B&F FK14 Polaris is a single engine, low wing ULM with two side-by-side seats, and tricycle landing gear.

The FK 14 is fitted with dual controls allowing it to be flown from both positions although the preferred pilot position would be the left one according to the instrument panel lay-out.

Designed in Germany it first flew in May 1999 and production started the next year.

The FK14B version remains in production being the last version.

Its carbon fiber wing is mostly of parallel chord. Toward the tips, where short span aluminum ailerons occupy the trailing edges, the leading edge is swept. Neither stall warning device nor stall strips are installed to induce or improve buffeting when approaching a stall condition.

Fowler flaps, electrically operated, are fitted.

The Polaris FK14B has spring-trimmed elevator control.

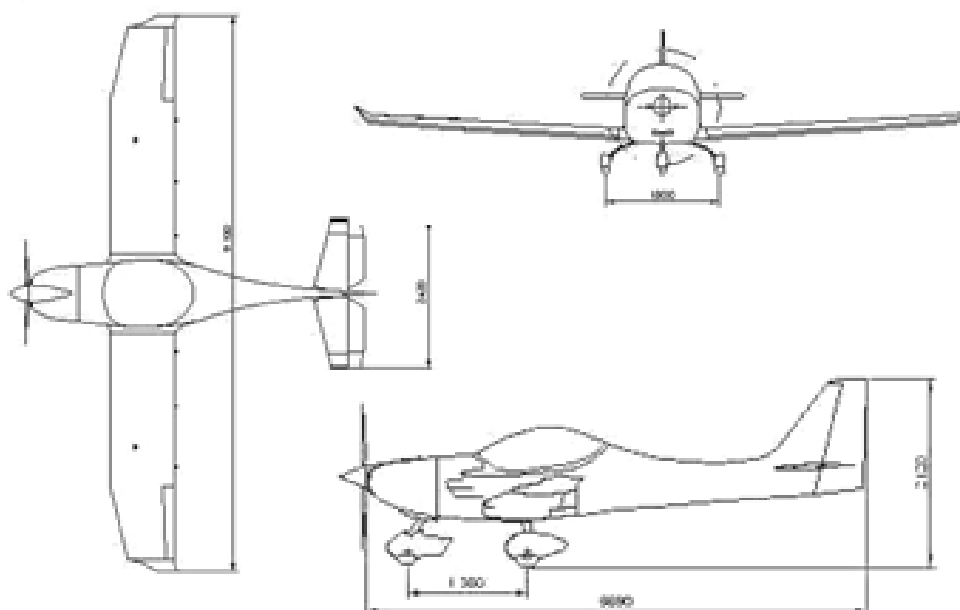
The undercarriage of the OO-G15 is of tricycle configuration, though a conventional undercarriage is an option.

OO-G15 was fitted with a Emergency Parachute Recovery System (Ballistic Recovery Systems, Inc. - BRS 6).

A Rotax 912ULS engine and a 3 blade "DUC" ground adjustable pitch propeller were fitted on OO-G15.

### General characteristics

- Crew: 1
- Capacity: 1 passenger
- Length: 5,69 m
- Wingspan: 9,04 m
- Height: 2,00 m
- Wing area: 9,10 m<sup>2</sup>
- Max takeoff weight: 472,5 kg



### Type authorization

On 18 October 2007, an ULM type authorization reference 2002-71 Issue 3/18-10-2007 was granted by the Belgian Civil Aviation Administration for the B&F TECHNIK FK 14B Polaris in the 450 kg maximum takeoff weight version (Authorization holder: CONFLUENCE S.C.R.L.)

On 22 February 2010, another ULM type authorization reference 2002-153 Issue 1/22-02-2010 was granted by the Belgian Civil Aviation Administration taking into account the BRS Parachute optional installation to increase the maximum takeoff weight to 472,5 kg. (Authorization holder: CONFLUENCE S.C.R.L.).

Both above mentioned ULM type authorizations were granted in accordance with Belgian Royal Decree dated 25 May 1999 and Belgian Circulaire AIRW-12, Ed. 5. The Type authorizations were based upon the original German type certification "Kennblatt Nr 61177.1" Edition 1 dated 18.06.2004.

### Airframe

- Manufacturer: B&F TECHNIK
- Type: Polaris FK14B
- Serial number: 084
- Built year: 2008
- Landing gear: tricycle
- Total flight hours: 414 FH
- Registration: OO-G15
- Certificate of registration: BCAA "Certificat d'enregistrement" N° 6608 issued on 30 September 2008
- The original Certificate of Airworthiness (Autorisation restreinte de circulation aérienne pour aéronef ultra-léger) was issued on 16 October 2008 for a maximum takeoff weight (MTOW) of 450 kg.
- On 23 March 2010, another Certificate of Airworthiness (Autorisation restreinte de circulation aérienne pour aéronef ultra-léger) was issued to increase the MTOW to 472,5 kg.
- Empty weight: 305 kg
- Owner: CONFLUENCE S.C.R.L.

### Engine

- Manufacturer: BRP ROTAX GmbH & Co. KG
- Type: 912 ULS FR
- Serial number: 6.374.178
- Total flight hours: 420 FH

### Propeller

- Manufacturer: DUC
- Type: 3-blade carbon fiber, fixed pitch
- Serial number: Unknown
- Total flight hours: Unknown

### Maintenance

The maintenance was regularly performed by the owner of the airplane.

### Loading: OO-G15 at the day of the accident

No weight and balance report was found in the wreckage.

Following the original factory delivered W&B report dated 18 September 2008, the empty weight of OO-G15 was 305 kg and the empty weight moment was 71,15 mkg.

There was about 1kg baggage in the rear baggage area. Reportedly, the weight of the pilot was about 98 kg and the passenger weight was about 80kg. There was about 40 litres fuel on board.

## Flight Manuals

No Flight manual was found in the wreckage.

Normally, OO-G015 would have been provided with a Flight Manual edited by "CONFLUENCE S.C.R.L." that applies to the FK 14 Polaris-B equipped with a BRS Parachute System.

The Flight Manual "FK 14 Polaris-B-Par" had been delivered to the Belgian CAA by "CONFLUENCE S.C.R.L." as being the official Flight Manual during the acceptance process for type authorization number 2002-153 Issue 1/22-02-2010.

This Flight Manual wears the reference "FK 14 Polaris-B-Par - Manuel d'utilisation et d'entretien" Issue IV dated 11/2009.

It mentions the following information about the Weight and Balance:

La masse à vide du FK 14 est de environ 272,7 kg et peut varier légèrement d'un appareil à l'autre. Le Centre de Gravité se trouve à 262 mm en arrière du bord d'attaque de l'aile, soit 24,9% de la corde.

La masse à vide de votre appareil particulier est indiquée sur la fiche de centrage et comprend les options installées d'origine à l'usine.

Si vous deviez installer ou enlever des options à posteriori, il serait impératif de recalculer le centrage de votre appareil.

*Translation:*

*The empty mass of the FK 14 which is around 272,7 kg can slightly vary from one aircraft to another. The center of gravity position is 262 mm rear of the wing leading edge which means 24,9% of the chord.*

*The empty mass of your particular aircraft is mentioned in the Weight and Balance report in which the factory installed options are included.*

*If you should later install or remove options, then it would be compulsory to recalculate the balance of your aircraft.*

An "Owner's Manual for BRS-6 Emergency Parachute Recovery Systems" was attached to the "CONFLUENCE S.C.R.L." Flight Manual.

For information:

*Selected extracts of "BRS 6" Owner's Manual:*

*Proper Activation Procedures:*

- *Kill the Engine*
- *Pull the Activating Handle*
- *Secure Restraint System*
- *Assume Emergency Landing Position*

Additionally, but Confluence reported it later, a "Pilot's Operating Manual and Approved Flight Manual" delivered by "B&F TECHNIK" was also available for the pilots in the offices of Confluence.

The airplane manufacturer “B&F TECHNIK” provides a “Pilot’s Operating Manual and Approved Flight Manual” reference 14B-000-1E revision 17 of December 2009.

This document which is available on the website of the manufacturer mentions an Empty Weight of 290,0 kg (§ 1.6. “Weight”).

#### **Type Certificate data Sheet information about the Empty Weight.**

- The original German type certification “Kennblatt Nr 61177.1” Edition 1 dated 18.06.2004 mentions:  
*“Empty Weight: 287 kg”.*
- The last edition of this German type certification “Kennblatt Nr 61177.1” Edition 4 dated 09.06.2010 mentions:  
*“See Weighting Report”.*
- The Compliance Certificate 61177.1 delivered by the German Certification Authority on 10 July 2009 mentions:  
*“The Standard Empty Weight does not exceed 297,5 kg”.*
- The “Confluence” Type Authorization Data Sheet 2010-153 for FK 14 Polaris-B-Par mentions:  
*“Standard Empty Weight: 272,7 kg.”*

#### **Maximum takeoff weight.**

Both the “CONFLUENCE S.C.R.L” Flight Manual and the “B&F TECHNIK” Flight Manual mention a maximum takeoff weight of 472,5 kg and all the mentioned airplane performances apply accordingly to this maximum takeoff weight.

However, other information can be found on the website of the manufacturer:

- *Demonstrated ultimate loads: +6,4g / -3,8g (540 kg)*
- *Max. Demonstrated takeoff weight: 540 kg  
(Certified MTOW according regulations relating specific state of immatriculation. Performance @ 475,5 kg).*

### **1.7. Meteorological conditions (At EBCI Airport)**

Wind direction:	260°
Wind speed:	6 kt
Temperature:	20° C
Dew point:	11° C
Visibility:	More than 10 km
QNH:	1017 HPa

### **1.8. Aids to navigation**

Not applicable

### **1.9. Communication**

No radio contact was established.

### **1.10. Aerodrome information**

Not applicable.

For information, the accident happened in a Class G Airspace below the TMA of EBCI airport. This class G Airspace extended from ground level to 2500ft.

### 1.11. Flight recorders

A GPS AVMAP model EKP IV was installed.

It was found in good condition after the crash and it has been possible to retrieve the last flight paths.

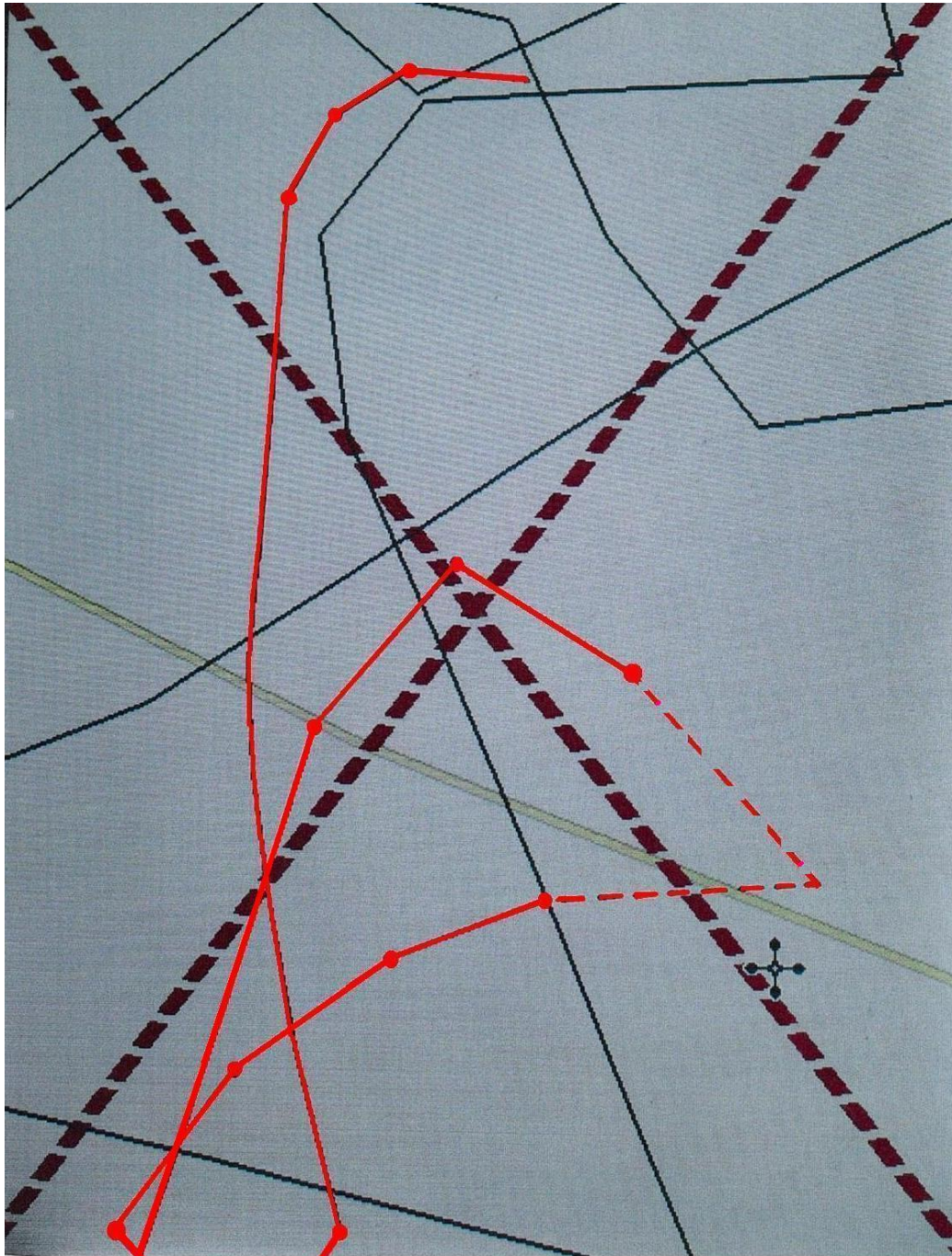
The next picture shows the last flight paths that were recorded by the GPS. The last flight of OO-G15 was colored red for the purpose of the investigation.

This GPS was set to record the geographical position of the airplane every five seconds.



The geographical position of the wreckage which was N50° 35.625' E04° 23.751' corresponds with the end of the red path on the GPS.





There was a loss of satellite reception of the GPS during the first turn to the right. This is shown on the picture by a dashed red line.

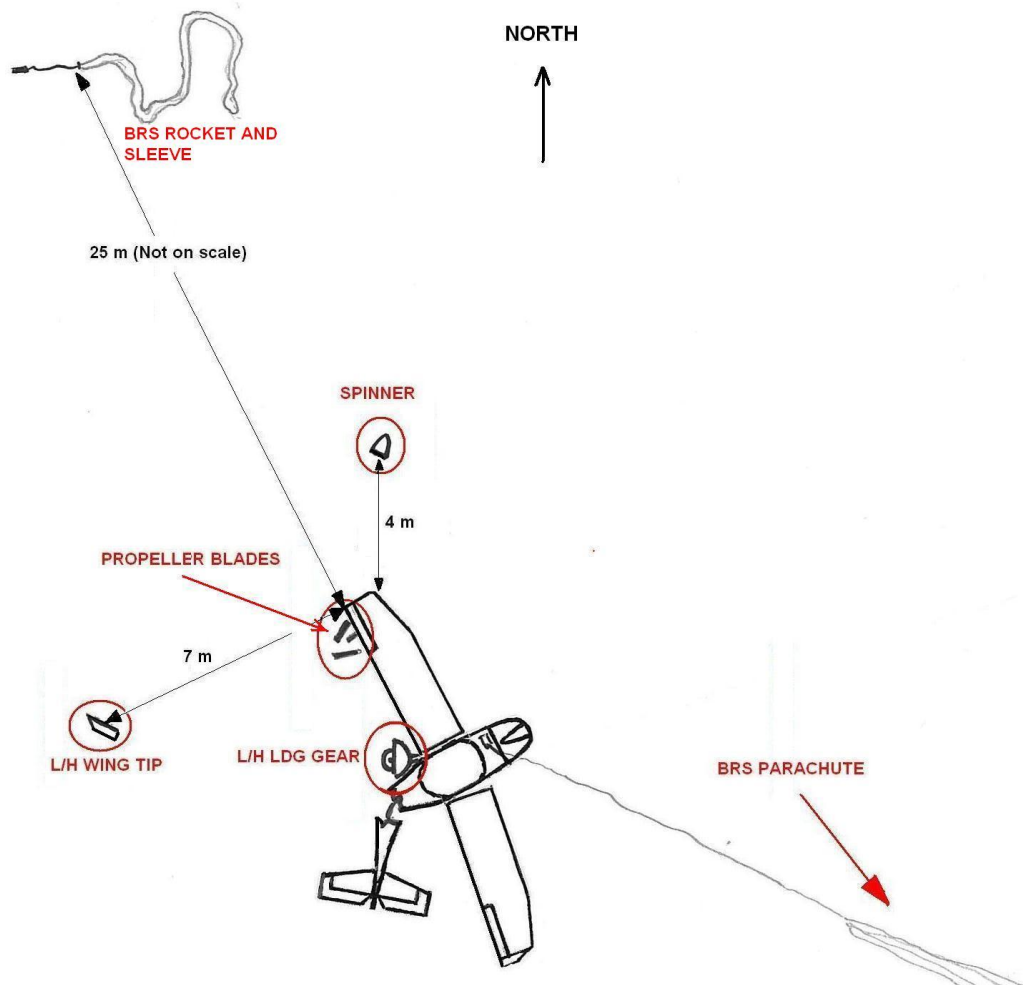


## 1.12. Wreckage and impact information.

The airplane impacted a reaped cornfield 5,8 kilometres north of the departure airfield of Buzet.



Due to the very dry and hard ground, practically no trace of impact was found.



The fuselage was orientated with the nose looking towards the northeast (70°) and the wings leading edges were orientated NW/SE.

The airplane wreckage was found complete but the tail was separated from the fuselage except that the elevator connecting rod and the two rudder cables were still connected to the fuselage.

The left hand wing tip was found about 7 m to the rear and left side of the fuselage. The propeller spinner was found at 4 m from the L/H wing.

The canopy had been removed by the rescue services after the crash.

The right main landing gear and the nose gear were folded under the fuselage and the left main landing gear was folded rear of the L/H wing.

The 3 blades of the propeller were found close together under the L/H wing and the L/H aileron. Two of them were complete and the third one was broken in two. 1/3 of its length was found remaining in the propeller hub.

The right hand underside of the engine showed evidence of heavy impact, particularly on the R/H exhaust system and on the oil reservoir which is located on the right side of the engine compartment.

The two vertical sides of the fuselage were broken above the wings

The R/H wing was more damaged than the L/H wing.



The flaps were set in the full retracted position.

The throttle control was found full forward. As the throttle was bent during the accident, its position is not regarded as significant.

The elevator trim was set slightly rear of the green area (Nose up position).

The master switch was ON and the fuel pressure warning light was flashing.

The electrical fuel pump switch was OFF.

The ignition switch was ON.

Both carburettor bowls were inspected on the accident site and were found to contain a normal quantity of fuel.



### 1.13. Medical and pathological information.

The occupants of the airplane died instantly from the impact

### 1.14. Fire.

There was no fire

### 1.15. Survival aspects.

#### 1.15.1. Parachute Rescue system

The aircraft was equipped of a BRS 6 rescue system from which the parachute extractor and the sleeve were found at 25 meters from the L/H wing tip, along the axe of the two wing leading edges.

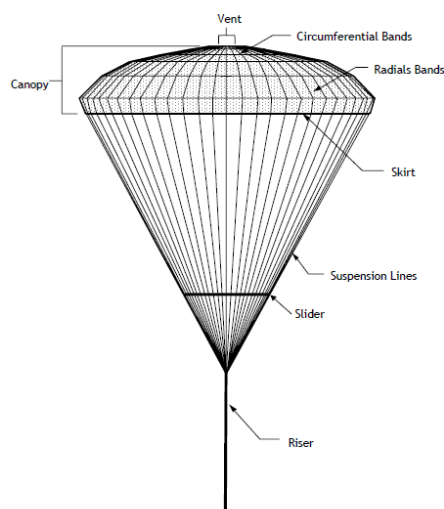
The parachute was found totally extracted. It was lying on the ground as a tube and was approximately oriented in the direction of the wind.

The slider of the parachute that limits the initial opening diameter of the parachute was found close to the riser.

All the straps of the parachute originated from the front baggage compartment where the BRS parachute package was installed.

The balance harnesses, which are installed in ducts along the fuselage to the aft airframe connection did not crack the skin of the fuselage as it should have.

The B.R.S. activating red handle was pulled out and its safety pin was found lying on the fuselage floor under the handle and between the legs of the pilot.



### **1.15.2. Safety belt and harnesses**

The pilot and the passenger both wore their ventral safety belt and their shoulder harnesses.

The steel cables connecting the shoulder harness to the structure of the fuselage were found broken (2,5 mm diameter cables).

The rupture was due to the force of the pilot's upper body inertia.



### **1.16. Tests and research**

Not applicable

### **1.17. Organizational and management information**

Not applicable

### **1.18. Additional information**

Reportedly there are a few known crashes of Polaris FK14 B due to loss of control and spins during stall exercises.

One pilot who survived a crash reported that the airplane went suddenly into spin during a stall exercise.

### **1.19. Useful or effective investigation techniques**

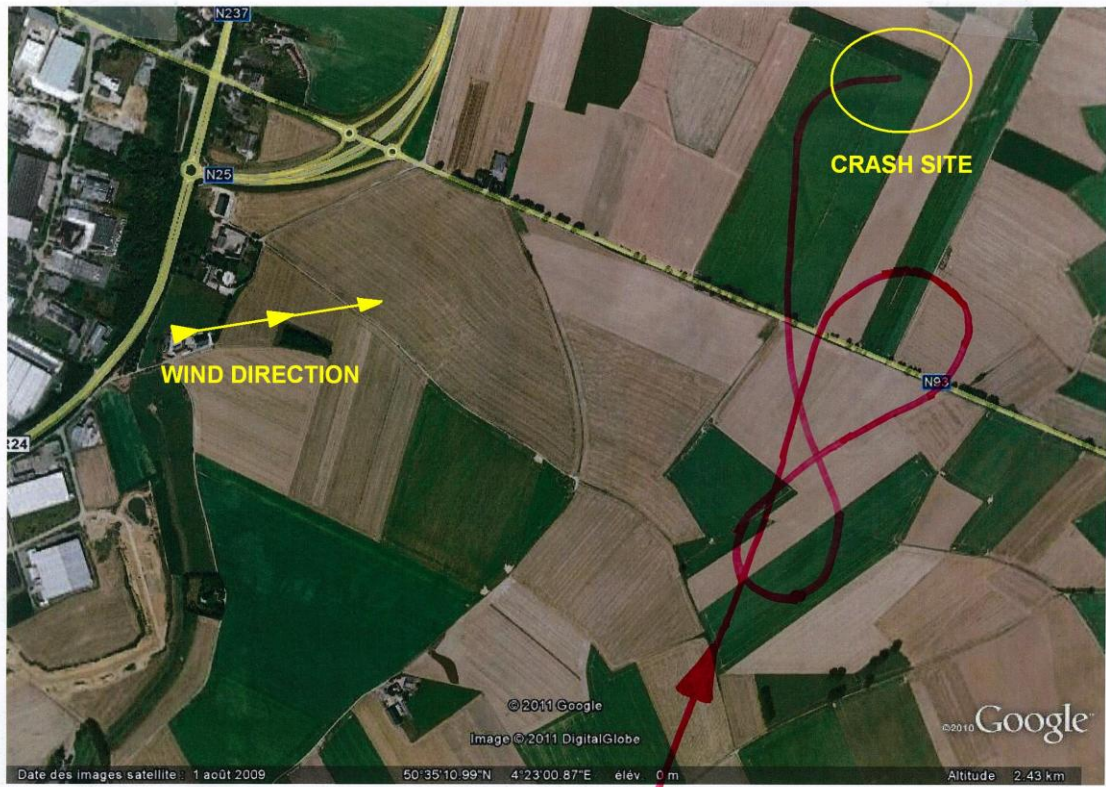
Not applicable

## 2. Analysis.

### 2.1. Flight path

As seen in paragraph 1.11, the GPS records the positions of the airplane each five seconds. Therefore the flight path issued from the GPS doesn't show the real track of the airplane but only straight lines between the successive position recordings.

Based on the GPS data, the last flight path has reconstructed and has been red coloured on the following Google Earth picture.



The airplane came from Buzet airfield and made first a right hand turn followed by a left hand turn.

These two turns were probably the “unconventional manoeuvres” reported a few days after the accident by a witness.

The GPS recorded positions were used to determine the ground speed of the airplane. Although, the inherent precision level of the recording does not allow an accurate computation.

The speed measured on the straight lines of the two first turns was around 150 km/h which means an estimated speed of 160km/h due to the actual curved pattern of the turns.

Then the airplane went to the north for a total distance of about 900m.

Finally, after the 900m flight to the north the airplane made a 90° right hand turn. The straight lines of this last turn were also measured allowing a determined approximate ground speed in straight line of 80km/h and a real ground speed of around 85km/h.

The last straight line to the east which is a little longer than the two other preceding straight lines of the last turn is not useable. This last stroke which is given by the last in flight position and the resting position of the wreckage could not be used to determine the ground speed.

When the accident happened the direction of the wind was approximately 260° with a speed of 6 kt (11 km/h).

## **2.2. Altitude analysis**

No reliable information about the altitude of the airplane was reported by the witnesses.

The airplane was flying in a Class G Airspace located under the TMA of EBCI airport. The TMA extend from 2500ft up to FL55 and the ground level in the vicinity of the crash is around 500ft.

It is likely that the pilot choose to fly at a maximum altitude of 2000ft to avoid the TMA infringement with as consequence that the airplane was flying at 1500ft above ground level or lower.

We can conclude that the height margin to recover the airplane in case of a spin was drastically limited.

## **2.3. The loss of control**

The damage to the airplane and the position of the different components such as the parachute extractor and the sleeve, the propeller blades, the left hand wing tip, the right hand main landing gear which was found under the fuselage, the left hand main landing gear which was found rear of the left hand wing trailing edge, the broken flanges of the fuselage and the broken rear part of the fuselage and the tail have been thoroughly examined.

This examination showed that the airplane hit the ground with a high vertical speed in a rotating movement to the left.

The airplane was making a left hand spin, which corresponds to the statement of a witness.

The left hand wing tip probably hit the ground first followed in a rebound movement by the propeller; the engine right hand underside and the landing gear.

The three landing gear legs collapsed laterally toward the rear and the left side and the tail section separated from the fuselage in a rotating movement to the right.

It is likely that a stall initiated the spin.

At least three conditions were present to induce a stall:

- The airplane was flying at very low speed
- The airplane was turning
- The airplane was overloaded

Following the “B&F Flight Manual” the onset of a stall is indicated to the pilot by many factors such as IAS (Indicated Air Speed), stick pressure, horizon level ... However, there is no mention of other indications such as buffeting.

The elevator trim of OO-G15 was found set in a “nose up” position. This setting is normal when the pilot wants to free himself of the back pressure on the stick when flying at low speed.

As the airplane was flying in overload and was turning, the actual stall speed was higher than the value mentioned in the Flight manuals (86 km/h in straight level flight - flap UP configuration) and was probably underestimated by the pilot.

The “FK 14-B airplane”, as most of the ULM Airplanes, is not fitted with a stall warning device or stall strips to induce or improve buffeting when approaching a stall condition.



For information, most of the CS23 Certified airplanes contain some form of this device that warns the pilot of an impending stall.

The CS 23 Regulation which is applicable to Normal, Utility, Aerobatic, and Commuter Category Aeroplanes but not to ULM airplanes states:

*(a) There must be a clear and distinctive stall warning, with the flaps and landing gear in any normal position, in straight and turning flight.*  
*(b) The stall warning may be furnished either through the inherent aerodynamic qualities of the aeroplane or by a device that will give clearly distinguishable indications under expected conditions of flight. However, a visual stall warning device that requires the attention of the crew within the cockpit is not acceptable by itself.*  
*(c) During the stall tests required by CS 23.201 (b) and CS 23.203 (a) (1), the stall warning must begin at a speed exceeding the stalling speed by a margin of not less than 9.3 km/h (5 knots) and must continue until the stall occurs.*

#### **2.4. Wreckage examination**

The analysis of the propeller remains shows that the engine was already stopped or delivering low power during the impact.

The carburetors contained a normal quantity of fuel and the thorough examination of the engine did not reveal any abnormality.

The engine throttle was found in the full power position but, as the throttle was bent during the accident, its position was not considered significant.

Moreover, the BRS parachute procedure of activation asks to first “Kill the Engine”. Power OFF is also required in standard spin recovery procedure.

It is therefore likely that the pilot reduced the engine power before pulling the BRS handle.

A thorough examination of the wreckage on the accident site did not reveal any missing part.

The flight control continuity has been inspected at the accident site and also later to confirm the absence of any pre impact damage that could explain the loss of control.

## 2.5. Weight & Balance

Summary of different information about the Empty Weight		
Manuel d'utilisation et d'entretien FK 14 Polaris-B-Par Issue IV dated 11/2009	Empty weight of FK 14 is about:	272,7 kg
Pilot's operating manual and approved flight manual" reference 14B-000-1E revision 17 of December 2009	Empty Weight (with rescue system):	290 kg
Gerätekenblatt 61177.1 Edition N°1 dated 18.06.2004	Empty Weight:	287 kg
Gerätekenblatt 61177.1 Edition N°4 dated 09.06.2010	Empty Weight:	See Weighting Report
"Confluence" Type Authorization Data Sheet 2010-153 for FK 14 Polaris-B-Par	Standard Empty Weight :	272,7 kg
Compliance Certificate 61177.1 delivered by the German Certif. Authority on 10 July 2009	The Standard Empty Weight :	Does not exceed 297,5 kg
Factory Original OO-G15 Weight and Balance report dated 18 September 2008	Empty Weight:	305 kg

Significant differences exist between the different sources of information about the Empty Weight.

As neither Flight manual nor Weight and Balance report was available in the wreckage it was impossible to know how the pilot managed the Weight and Balance and if in fact he did it.

If the pilot had used the information contained into the official "Manuel d'utilisation et d'entretien FK 14 Polaris-B-Par Issue IV dated 11/2009" as a base to estimate the Weight and Balance the result should have been the following:

	Weight (kg)	Arm (m)	Moment (mkg)
Empty Weight	272,7	0,262	71,447
Pilot	98	0,57	55,86
Passenger	80	0,57	45,60
Fuel	29	0,57	16,53
Baggage	1	1,21	1,21
Total	480,7	0,397	190,65

If the pilot had used the actual OO-G15 empty weight of 305 kg as a base to estimate the Weight and Balance the result should have been the following:

	Weight (kg)	Arm (m)	Moment (mkg)
Empty Weight	305	0,23328	71,150
Pilot	98	0,57	55,86
Passenger	80	0,57	45,60
Fuel	29	0,57	16,53
Baggage	1	1,21	1,21
Total	513	0,371	190,35

The actual calculated total weight of the airplane at the time of the accident was therefore about 513 kg. The moment was about 190 mkg which correspond to a center of gravity position of 0,370m from the datum.

This total weight was significantly above the certified Maximum Take Off Weight of 472.5 kg but the centre of gravity remained within the limits (0,280 to 0,431).

For information, the “B&F TECHNIK” Flight Manual Nr 14B-000-1E, Revision 17 of December 2009” states in § 6.1.

*To achieve the mentioned performance data and flying abilities, the aircraft must be operated within certified weight and balance limits.  
Although the aircraft has a wide range for weight and balance, it is not possible to fly with full baggage load, full fuel and 2 heavy pilots at the same time.  
Wrong loading has consequences for every airplane:  
An aircraft exceeding weight limits will need longer takeoff- and landing distances, climb performance will be decreased and stall speed increased.  
A wrong center of gravity will change the flying abilities.  
A forward C.G. may cause problems during rotation, takeoff and landing.  
An aft C.G. may cause instability, inadvertent stall or even spin.*

Due to the overweight of about 40kg we can conclude that the actual stall speed of the airplane was higher than the value mentioned in the flight manuals (86km/h in flaps up configuration and straight level flight).

For information, the calculated stall speed for the actual weight of the airplane would have been around 89km/h in straight level flight.

#### Note about the maximum takeoff Weight

The following information can be found on the web site of the manufacturer:

- *Demonstrated ultimate loads: +6,4g / -3,8g (540 kg)*
- *Max. Demonstrated takeoff weight: 540 kg (Certified MTOW according regulations relating specific state of immatriculation. Performance @ 475,5 kg).*

However, the most reliable information published by the manufacturer about the airplane performances is the “Pilot’s Operating Manual and Approved Flight Manual” reference 14B-000-1E revision 17 of December 2009. This manual refers to performances at 472,5 kg and does not give any information about the aircraft performances above 472,5 kg.

Furthermore, no reliable information about the airplane performances when heavier than 472,5 kg can be found somewhere else.

We can conclude that the above information regarding the maximum demonstrated take off weight and the demonstrated ultimate loads at 540 kg are ambiguous because they could influence the pilots to think that they can fly their airplanes up to 540 kg without problem.

## **2.6. The Emergency Parachute Recovery System.**

The indications on the crash site pertaining to the B.R.S. show that there was insufficient height available upon actuation.

In particular, the ducts and the foils installed along the fuselage that were found undamaged prove that the tension in the balance harnesses of the parachute remained low.

The safety pin being found on the fuselage floor could mean that it was still engaged in flight. However this couldn’t be confirmed.

As the parachute remained opened for at least five minutes at ground level after the crash, the slider position found close of the riser is not relevant to prove its full opening in flight.

We can conclude that the B.R.S. was activated at a height that could not allow the development of the full effect of the parachute.

## **2.7. The safety belts and shoulder harness cables.**

The pilot and the passenger wore their ventral safety belt and their shoulder harnesses.

The 2,5 mm diameter cables connecting each shoulder harness to the structure of the fuselage were found broken by the impact force of the accident.

On the other hand, the attaching points of the airplane structure and the harnesses withstood the forces without any apparent damage.

However, it is likely that the high vertical speed impact force into the ground was not survivable even if the shoulder harnesses cables had withstood.

For information, the attaching points of the safety belts on the structure of the airplane including those of the safety harnesses had been tested and found satisfactory by the manufacturer during the certification process (Static test only).

The manufacturer determined by calculation that the 2,5 mm diameter cable were satisfactory.

It has to be noted that neither the German specification for ULM airplane or the Belgian regulation require complete dynamic tests to demonstrate a sufficient efficiency of the seat/restraint system as for example the CS 23.562 regulation does for Normal, Utility, Aerobatic, and Commuter Category Aeroplanes.

It has also been determined that most of the CS 23 certified airplanes that use cables to connect the shoulder harnesses to the structure have a diameter of 4 or 5mm; significantly larger than the 2,5 mm diameter used here.

## 2.8. The Flight Manuals

Significant differences exist between the OO-G15 applicable “CONFLUENCE S.C.R.L” Flight Manual and the “B&F TECHNIK” Flight Manual relating to authorized manoeuvres, the danger of stall and spin and the weight and balance.

The “B&F TECHNIK” Flight Manual contains a lot of information and Warnings to inform pilots about the danger of stall and spin. Example:

*Note regarding spins:*

*In the light aircraft/ultralight category spinning is strictly prohibited and is not required to demonstrate during flight test program.*

*Despite this all FK aircrafts have also been tested regarding their general spin characteristics.*

*In general it is important to know that a spin is a very complex flight condition and relates to many individual factors like operation weight, centre of gravity, mass distribution, aerodynamic conditions, number of spin turns already performed, kind of control deflections already made and so on.*

*For example, the spinning characteristic of the same aircraft on the same day can differ significantly because of differences in mass distribution or dirt on surfaces. This can cause a “non recoverable” spin-condition!*

*In practice this means that flying into stalls on purpose must be avoided and recovery procedures have to be performed immediately! Spinning any aircraft which is not certified for this manoeuvre is extremely dangerous!*

In contrast the “CONFLUENCE S.C.R.L” Flight Manual does not give any information or warning about the danger of spin and the recovery procedure.

The information and warnings about the danger of stalls are less imperative in the “CONFLUENCE S.C.R.L” Flight Manual. This manual even suggests that pilots experience flights close to the stall speed and test the stalls. Example:

*“En jouant avec les gaz, vous pouvez tester les décrochages qui vous démontreront un léger tremblement des gouvernes et le redressement rapide »*

*Translation: « When moving engine throttle you can test the stalls that will show you a slight buffeting of the controls and a quick recovery”.*

## 2.9. Pilot License

There is no international standard, no automatic equivalence or recognition of the ULM Pilot license as in the case of ICAO certified aircraft pilot license.

That means that the civil aviation authority of each state determines independently the rules and qualifications that apply to all the ULM pilots flying above that state.

Consequently, unless otherwise stated by the authority, to fly an ULM aircraft, a pilot would need to hold a license requested by the authority of the over flown state.

In Belgium, the Royal Decree number 1990014155 dated 25 May 1999 is applicable for the delivery of ULM Pilot Training Licenses and ULM Pilot Licenses. (Articles 30 to 39 of the Royal Decree pertain on the subjects).

This regulation states that the holder of such a training license is allowed to perform:

- Dual control flights with an instructor
- Local flights alone under the supervision of a instructor
- Non local flights alone under the permission of an instructor....

The pilot of OO-G15 held a Belgian ULM Training License and also a French ULM license.

- The French license was valid to fly in France with a passenger.
- The French license was also valid to fly in Belgium with a passenger, provided that the ULM was French registered and accepted by the Belgian CAA to fly above Belgium.
- The Belgian ULM Training License restricted the pilot flying in a Belgian registered ULM to dual control flights with an instructor, local flights alone under the supervision of an instructor or non local flights alone under the permission of an instructor.

The total pilot experience was unknown. However, the demonstrated experience beginning 18 June 2009 was 28:21 from which 10:35 as pilot in command on different types of ULM's.

His experience on B&F TECHNIK FK 14B Polaris was 17:18, including 7:35 as Pilot in command.

The passenger was in the past an ULM instructor pilot who was currently holding only a French ULM pilot license.

He had a more limited flight experience on the Polaris FK 14 B than the first pilot.



### 3. Conclusions.

#### 3.1. Findings.

- The airplane was technically fit for the flight.
- No pre impact anomalies could be found that would explain the loss of control in flight. All the damage found on the wreckage was due to the force of the impact.
- The pilot held a Belgian ULM Training Licence and a valid French ULM Pilot license
- The airplane was flying at a very low speed close to the stall speed during the last leg (moment) of the flight.
- The airplane was probably flying at an insufficient altitude to practice flight at low speed.
- The computation of the Weight & Balance of the airplane for the last flight shows it was about 40 kg in overload.
- The OO-G15 factory original Weight & Balance report was not found on board.
- The “Confluence” Flight Manual gives only generic data regarding the Weight & Balance and an empty weight significantly lower than the actual weight of OO-G15.
- The BRS was activated at a height that could not allow the development of the full effect of the parachute.
- The structure of the cabin compartment withstood relatively well the impact force but the retaining cable of the shoulder harnesses broke on impact.

#### 3.2. Causes.

The probable cause of the accident is a loss of control during a flight at very low speed.

##### **Contributing factors**

- The incitation to experiment stall exercises and the lack of information and warning about stall and spins in the “Confluence” Flight Manual probably prevented the pilot realizing the potential danger of these maneuvers.
- Unclear information about the actual empty weight of OO-G15 and ambiguous information regarding the maximum demonstrated take off weight of 540 kg probably led the pilot to fly in overload. However, taking into account that the pilot’s weight was relatively high it is likely that the fatal flight was not the first flight in overload.
- The absence of stall warning system probably prevented the pilot to adequately realize the proximity of stall.
- The choice of a training area below the TMA of EBCI Airport did not allow the pilot to climb to a safe altitude to make low speed exercises.



#### **4. Safety recommendations.**

##### **4.1. Recommendation 2011-U-9 to the Belgian ULM Federation**

AAIU(be) recommends the Belgian ULM Federation inform ULM pilots about the publication of this report, for example in the “News Letter” publication, and to encourage them

- To only make low speed or stall exercises at a safe altitude.
- To obtain actual (not “standard”) empty weight and cg of the individual airplane they are operating.
- To compute the Weight and Balance and to sensitize them to the danger of flying in overload.

##### **4.2. Recommendation 2011-U-10 to the Belgian CAA**

AAIU(be) recommends the Belgian Civil Aviation Authority improve Belgian Regulation (CIR/AIRW-12) in order that all the Flight or Owner Manuals :

- Contain, without any alteration, all Instruction Warning and Caution notes found in the Original Aircraft Manufacturer Flight manual.
- Mention the actual Weight and Balance data of the individual airplane or refer to the Weight and Balance report of the individual airplane.
- Do not contain any information regarding the Empty Weight of a non-realistic “stripped” airplane.

##### **4.3. Recommendation 2011-U-11 to B&F TECHNIK**

AAIU(be) recommends the manufacturer B&F TECHNIK install stronger cables to connect the shoulder harnesses to the structure of the airplane.

##### **4.4. Recommendation 2011-U-12 to B&F TECHNIK**

AAIU(be) recommends the manufacturer B&F TECHNIK improve indications for the pilot when approaching the stall for example by developing an optional electrical stall warning system or stall strips to make the buffeting more evident.