Federal Public Service
Mobility and Transport
Air Accident Investigation Unit

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## Safety Investigation Report

# ACCIDENT TO DPM MICROBEL EQUIPPED WITH ORYX WING AT ISIERES ON 7 SEPTEMBER 2013

**Ref. AAIU-2013-AII-8**
**Original Issue date: 9 October 2014**
**Status: Final, revision 1 dated 20 November 2014**

## 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 and EU Regulation 996/2010, 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 17-3 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 for which the recommendation is concerned. It is for those Authorities to decide what action is to be taken.

The investigation was conducted by Henri Metillon, Sam Laureys and Luc Blendeman.

The report was compiled by Henri Metillon and Luc Blendeman and was published under the authority of the Chief Investigator.

NOTES:

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

2. ICAO document 9859 *Safety Management Manual* was used to identify the hazard and the consequences related to the accident.

## SYMBOLS AND ABBREVIATIONS

| | |
|---|---|
| AAIU(Be) | Air Accident Investigation Unit (Belgium) |
| AGL | Above Ground Level |
| ARCA | Autorisation Restreinte de Circulation Aérienne = Permit to Fly |
| BCAA | Belgian Civil Aviation Authority |
| BEA | Bureau d'Enquêtes et d'Analyse (French authority responsible for safety investigations into accidents or incidents in civil aviation) |
| BHP | Brake horsepower |
| CANAC | Belgian Air Traffic Control Centre (Part of Belgocontrol) |
| DPM | Delta Plane Motorisé (Ultralight Weight-Shift Control Aircraft) |
| EASA | European Aviation Safety Agency |
| EBIS | Ath - Isière ultra-light airfield |
| LT | Local Time |
| m | Meter(s) |
| METAR | Meteorological Aerodrome Report |
| PIC | Pilot in Command |
| QFU | Magnetic bearing of the runway |
| QNH | Pressure setting to indicate elevation above mean sea level |
| RPM | Revolutions per Minute |
| RWY | Runway |
| ULM | Ultra Léger Motorisé (Ultralight Aircraft) |
| UTC | Universal Time Coordinated |
| VNE | Never Exceed Speed |

## SYNOPSIS

| | |
|---|---|
| Date and hour of the accident: | 07 September 2013 at 16:40 UTC |
| Aircraft: | DPM: 'Microbel TD 1+1' trike serial number 89-121 with a 'La Mouette Oryx' wing |
| Accident location: | 600 m from EBIS airfield.<br>N 50° 40' 7.8" - E 003° 48' 24.2" |
| Aircraft owner: | The pilot |
| Type of flight: | General Aviation - Local |
| Persons on board: | 1 pilot + 1 passenger |

**Abstract:**

An Ultralight Weight-Shift Control Aircraft (in French a deltaplane motorisé or DPM) took off from the airfield of Isières (EBIS) around 16:15 with a pilot and a passenger. The purpose of the flight was to perform a local flight. Around 25 minutes later, the DPM was last seen coming back to the airfield by a witness standing at a distance of 650m. The DPM was turning to the right, and diving. The witness heard the shock of the airplane hitting the ground. Both occupants were killed on impact.

**Cause(s):**

The accident was caused by a loss of control further to a steep descent manoeuvre initiated by the pilot before landing. It is likely that the pilot was surprised by an unexpected behaviour of the aircraft caused by the poorly performed and unapproved aircraft modifications.

**Contributing factor:**
The repetitive non-compliance with the applicable circuit pattern of EBIS airfield was not reported to the Belgian CAA as it is required by the regulation. This prevented the BCAA to have the opportunity to call the pilot to order.

**Hazard identified during the investigation[1]:**

Application of unapproved modifications to aircraft.

**Consequence[2]:**

Unexpected handling of aircraft.

[1] Hazard – Condition or object with the potential of causing injuries to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function.
[2] Consequence – Potential outcome(s) of the hazard

# 1 Factual information

## 1.1 History of flight

On September 7th 2013 around 16:15 UTC, the pilot took off with a passenger on board a DPM from the airfield of Isières (EBIS).

The DPM consisted of the association of a La Mouette Oryx wing and a Microbel TD 1+1 trike. The 'Oryx' wing was a used wing bought in France by the pilot in March 2013.

Reportedly, the pilot was familiarising himself with this new trike/wing configuration.

The purpose of the flight was to perform a local flight with the passenger, a friend of the pilot.

Nobody saw the aircraft during the last phase of the flight, except the only witness of the accident standing 650m away from the crash zone. The DPM was seen turning to the right and diving. The witness heard the shock of the DPM hitting the ground.

Both occupants were killed on impact.

AAIU(Be) was notified by CANAC at 19:13 LT. A team of 2 investigators arrived at the crash scene at 20:30 LT and started the investigation.

## 1.2 Injured 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.

## 1.4 Other damage

Minor damage to a fence.

## 1.5 Personnel information

**Pilot**

| | |
|---|---|
| Sex: | Male |
| Age: | 63 years old |
| Nationality: | Belgian |
| License: | Holder of a Ultralight Aircraft Flight Authorization issued in Belgium, first on 19/03/1987, last on 20/06/2013. Valid until 23/05/2014. |
| Rating: | Delta Plane Motorized |

Flight Experience (from the pilot log book): around 900 FH

Notes:

1. Reportedly, the pilot was eager to fly and, although he had a quite active life, he spent all his spare time on flying for pleasure, often alone but recently more and more often with a friend.
2. Reportedly, 15 days after the first flight with the new Oryx wing, the pilot explained to a fellow pilot that he was a little disappointed with the new wing behaviour, as it was “less manoeuvrable” than the one he was used to. The fellow pilot understood that he actually meant he had the impression the new wing was less “forgiving” than the previous one. Another fellow pilot had also a chat with the pilot and his impression was opposite; he thought the pilot told him that the new wing was “too stable” to his liking.
3. The pilot did not regularly apply a standard circuit pattern while landing in EBIS. Instead, he was approaching the base leg at a higher altitude and descended by applying one or more 360° steep descending turns, exiting to the final leg when the required altitude was reached.
4. The airfield log book records show only a fraction of the flights made by the pilot with the aircraft owned by the pilot.
5. The pilot log book does not show any flight after May 28, 2013.
6. There are 13 flights registered between March 7, 2013, the date of the purchase of the Oryx wing and May 28, 2013, for a total of 16.75 FH. The exact type of wing used to perform these flights is unknown.
7. Reportedly, the pilot had made little use of the new wing in the spring period and flew in July and August for a total of around 10 FH. These flights, performed in July and August, were not registered in the pilot’s log book or in the airfield log book.

## 1.6 Aircraft information

### History

The pilot was the owner of a DPM made of a La Mouette Chronos 14 wing and Microbel TD 1+1 trike powered by a Rotax 503B engine. This combination was type approved by the BCAA and a Permit to fly (in French Autorisation Restreinte de Navigation Aérienne – ARCA) was delivered to the DPM on 9 November 2000.

After a while, the pilot replaced the original wing by a La Mouette Chronos 12.9 wing. This change was not reported to the BCAA and therefore this major change to the aircraft was not approved by the aviation authority.

On March 7, 2013, the pilot purchased another wing, a La Mouette Oryx 14.9 - a second-hand wing manufactured in 2010. This wing still wore the former French registration. This wing was overhauled by the manufacturer prior to the sale.

The overhaul of the wing consisted in the replacement of all cables and unions, and the inspection of the sail and the structure. The pilot purchased also a universal joint for the purpose of attaching his trike to the new wing.

Reportedly, the pilot installed the Oryx wing on his trike in the spring period but this wing had not been widely used due to engine problems and the adverse weather conditions. The engine problems were only solved beginning of July by the installation of a new carburetor.

Again, this last wing change had not been submitted for acceptance to the BCAA.

The pilot started a series of tests and familiarizing flights with the new combination (Oryx wing and Microbel trike), the new wing still wearing its former French registration. The tests and familiarizing flights were not logged in the airfield log book or in the pilot log book.

**General Data**

- Type: DPM (Weight-shift Control Aircraft)
- Manufacturer: Microbel
- Model: TD 1+1, 503B, Chronos 14 (As per ARCA)
- Serial number: 89-121
- Built year: 1989
- Certificate of Registration: N° 5.939 issued by BCAA on January 19th, 1990
- Permit to fly: ARCA ref D-1999-246 Issued by Belgian CAA on November 9, 2000
- Type Authorization: 94-004/10 Issue 1/13-06-2000
- Airplane total time: around 900 FH

The above data pertains to the original airplane configuration (Microbel TD 1+1 trike and La Mouette Chronos 14 wing). NB: an ARCA (Permit to Fly) remains valid as long as the aircraft configuration remains in conformity with the type authorization i.e. same combination of trike, wing and engine.

**Figure 1: A DPM with Oryx wing**

**Figure 2: A DPM with Chronos wing**

Note: both pictures here above are typical DPM, not the damaged plane.

**Wing** (the one installed when the accident occurred):

- Manufacturer: La Mouette
- Type: Oryx14.9
- Manufacturing year: 2010

**Trike:**

- Manufacturer: Microbel
- Type: TD 1+1
- Serial number: 89-121
- Manufacturing year: 1989

**Engine:**

- Manufacturer: Bombardier Rotax
- Type: 503B
- Serial number: 3815870

**The wing of the accident airplane**

The Oryx wing is a topless delta wing with struts (without king post and top wires). The wing is equipped with strong carbon made side-struts meant to sustain the structure up to 3G in negative acceleration and 6G in positive acceleration.

General Characteristics Oryx 14.9 wing

- Speeds: 50 km/h (stall) – 148 km/h (VNE)
- Wing surface: 14.9 m2
- Wing Span: 9.73m
- Weight: 53 kg
- Glide ratio: 9.8

The reflex system

A hang glider or a DPM sail wing is flexible by design meaning that control and stability depend, among others, on maintaining a given wing profile in all circumstances. Preserving an adequate wing profile is particularly important when the wing is unloaded or even negatively loaded.

In order to maintain positive pitch stability[3] the trailing edge near the root and the tips must stay up during unusually low or negative angles of attack. These upward twists (also called "washout") are maintained by special pitching devices which affects the airfoil reflex, the natural tendency to return to a neutral position.

During the development of a new wing design, the manufacturer performs a lot of tests to find an acceptable compromise between controllability, stability and speed.

In particular, tests are performed with different upward twists through which raising or lowering the trailing edge near the wing tip affects airfoil reflex characteristics[4] and also changes the trim speed of the wing.

- Less upward twist at the trailing edge near the wing tip increases the trim speed and makes the wing less stable.
- More upward twist at the trailing edge slows the trim speed of the wing and makes it more stable.

[3] Positive pitch stability: when a disturbance causes a change in the angle of attack, the pitching moment also will change in order to restore the initial attitude of the aircraft.
[4] Reflex characteristics means the characteristics that naturally tend to return the wing to a neutral position.

A drawing of a typical wing without king post and reflex cable is shown hereunder. This drawing shows that the twist of the wing is obtained by both the washout strut and the internal sprog. The vertical upwards force of the sprog acts on a transversal rod which itself maintains the 2 neighbouring battens upwards.

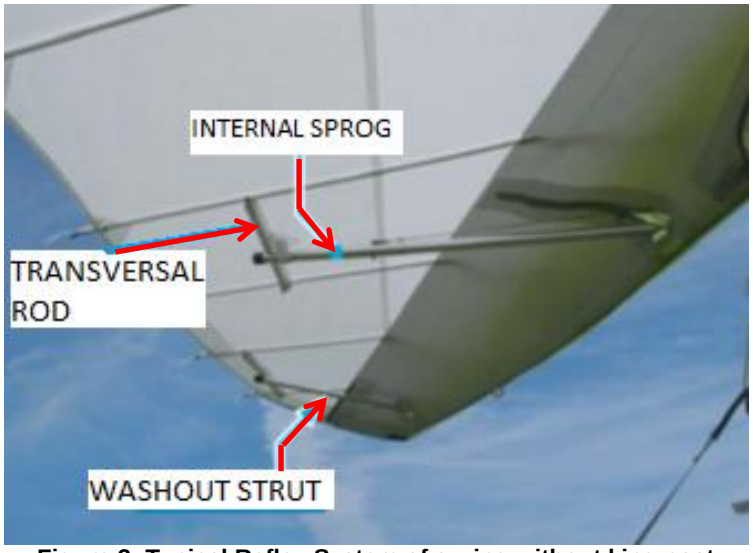



**Figure 3: Typical Reflex System of a wing without king post**

The reflex system of the Oryx wing is comparable to the one shown on the above drawing. It features:

- Washout struts – longitudinal tubes fixed near the tips keeping the tip trailing edges up. (NB: Washout struts are used both for wings with or without king post).
- Internal sprogs (called also internal washout sprogs), combined with transversal rods, are maintaining the position of the internal wing trailing edges. This is a typical design for wings with side struts and no king post.

The purpose of the internal sprog is to hold onto place the transversal rod and consequently also the battens N° 8 and 9 causing an upward twist of the trailing edge

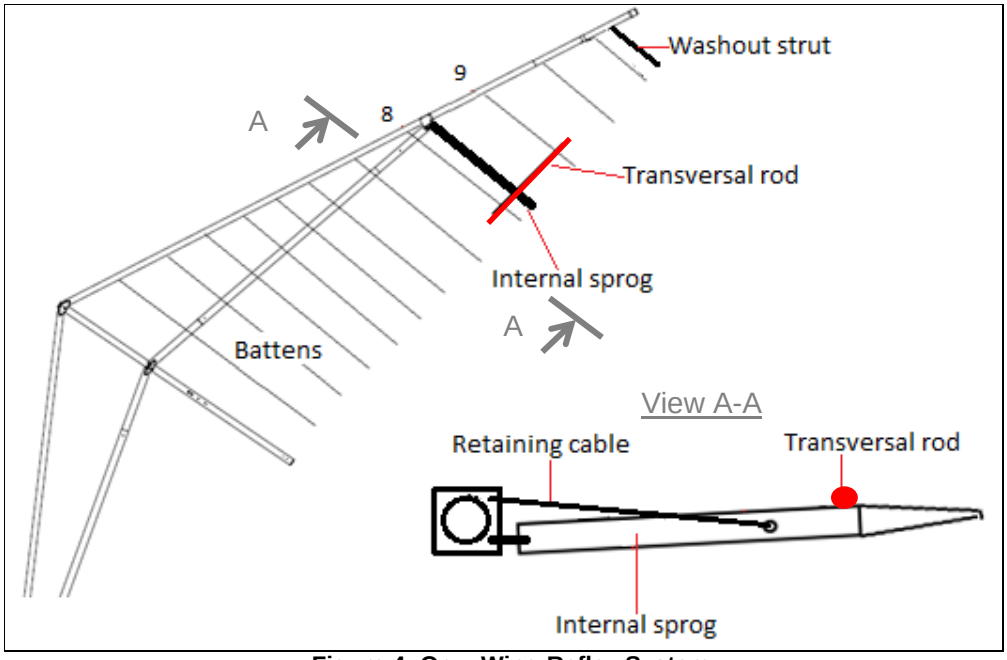



**Figure 4: Oryx Wing Reflex System**

## 1.7 Meteorological conditions

The meteorological observations around the time of the crash made in EBCI, the closest airport, were:

- Wind direction and speed: 150°, 6kts (Around 11km/h).
- Few clouds at 3000ft.
- Temperature: 17°C and Dew point: 11°C.
- QNH: 1019hPa.

## 1.8 Aids to navigation:

None

## 1.9 Communication:

None

## 1.10 Aerodrome information

- The EBIS Ath – Isière ULM airfield is located 1 km West of the village of Isières, between the cities of Ath and Lessines; near the right bank of the river Dendre. Location: N50 39 54 / E003 48 21.
- It features a bi- directional grass runway, oriented 17° / 35°.
- Runway dimensions: 151 x 50m.
- Elevation: 98 feet.
- Take-off and landing pattern: LH when taking-off and landing on the Runway 17.
- A RH circuit is prescribed for take-off and landing on Runway 35.

The runway in use when the accident occurred was Runway 17.

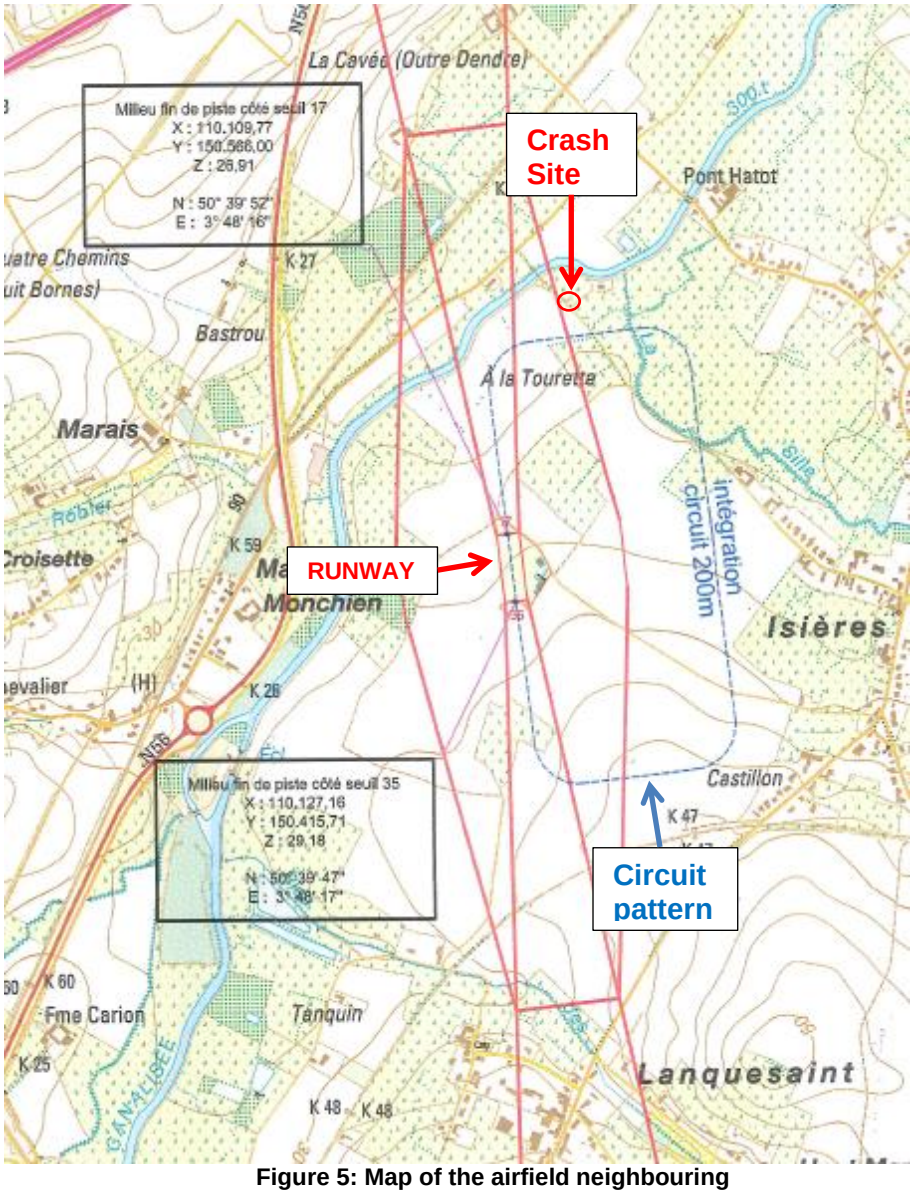



**Figure 5: Map of the airfield neighbouring**

The following circuit procedure applies to the EBIS airfield for the landings:

- Arrival at vertical of terrain at 200 meters AGL
- Checking the Signals square
- Turning East
- Circuit integration (Left or Right)
- Descent to 150 meters in downwind
- Performing the last two turns
- Aligning in final and landing

## 1.11 Flight recorders

The DPM was not equipped with a flight recorder, nor was it supposed to. However, a video camera owing to the passenger was systematically installed on the structure of the trike for the purpose of recording the flights with the passenger on board.

The memory card was retrieved after the crash. It suffered internal damage consecutive to the shock.


**Figure 6: SD card retrieved from the wreckage**

The SD card was sent to the laboratory of BEA-France that made a thorough inspection of the internal circuit. A read-out of the memory, however, was not possible. However, there are still, at the date of the publication of this report, discussions in progress with a specialized company for another attempt to recover the data.

Other flights previously recorded on the SD card had been transferred and kept in the passenger's personal computer before the crash. These videos were retrieved and showed the pilot flying habits.

Amongst other, one GoPro record shows the DPM diving and making a steep 720° turn in 17 seconds near the airfield, before directly landing. This video was taken when the DPM was still equipped with the old La Mouette Chronos Top 12.9 wing.


**Figure 7: Example of steep descending turns originating from the GoPro camera.**

## 1.12 Wreckage and impact information.

### 1.12.1 Observations on the crash site

The aircraft crashed on the Chemin de la Tourette, in the village of Isières at a distance of 600 m from the EBIS airfield, near the Dendre river. The area is flat, with cultivated fields. The actual position of the wreckage is N 50° 40' 07.8" – E 3° 48' 24.0".

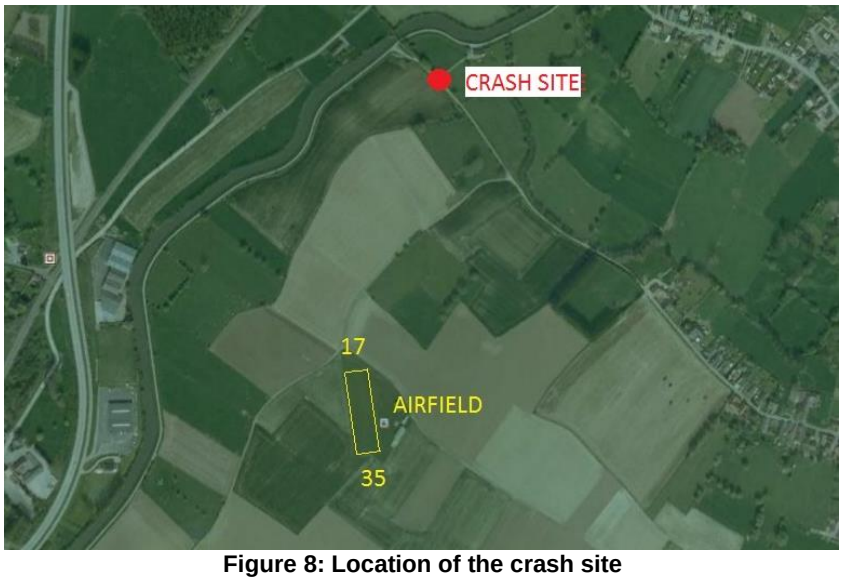



**Figure 8: Location of the crash site**

The aircraft hit the ground at a steep flight path angle and left a trace on the pavement. The aircraft bounced and came to a halt four meters further. The first impact area shows damage to the trees, including remnants of the wing cover and traces of oil and gasoline on the pavement.

The wing itself, with the trike still attached, was resting 4 meters away showing multiple fractures to the structure.

The pilot was found within the remains of the trike. The engine and the propeller with two ruptured blades was lying 5 m behind. The passenger was found 9 meters beyond the main wreckage, in the same orientation as the engine.

Smaller parts were found on the other side of the Chemin de la Tourette, such as fractured tubes and stiffeners.

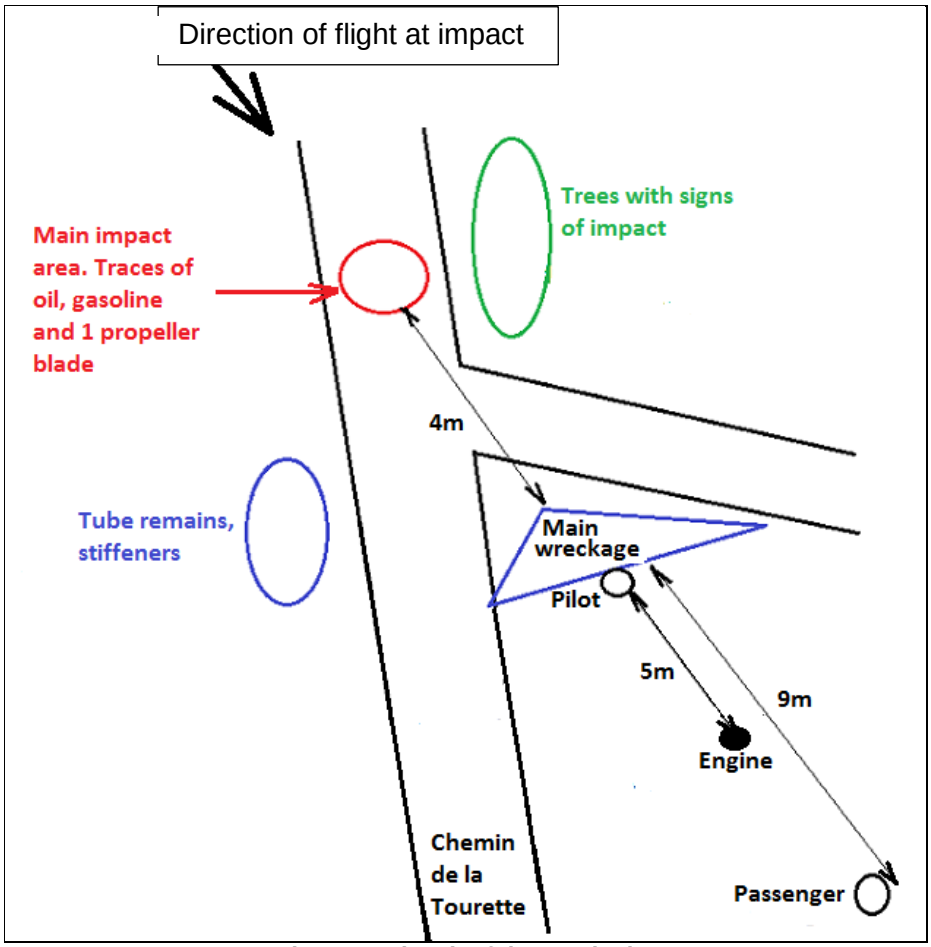



**Figure 9: Sketch of the crash site**

### 1.12.2 Thorough inspection of the wreckage

The wreckage was inspected on 12 September 2013 with the support of the trike manufacturer. The manufacturer of the wing – La Mouette – provided documentation to perform the inspection of the wing.

The wing

The sail fabric showed minimal damage. The sail structure showed several fractures, mainly in its LH part. The Leading edge tubes showed 3 fractures; 2 on the LH side (N°2 and 3); one on the RH side (N°1); all fractures are static.
The LH tube and the interior of the wing, on its left side showed presence of foliage and dirt. The RH leading edge tube showed a series of dents. The keel structure was intact. The nose plate showed no damage, nor presence of dirt.

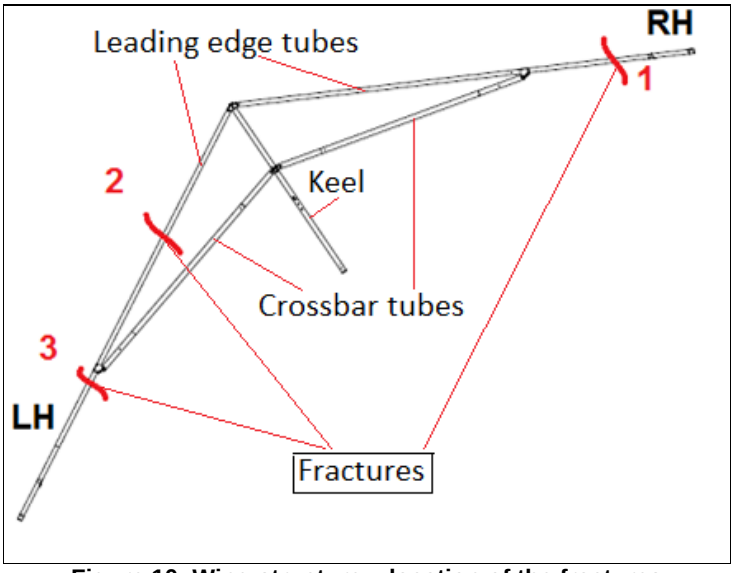



**Figure 10: Wing structure – location of the fractures**

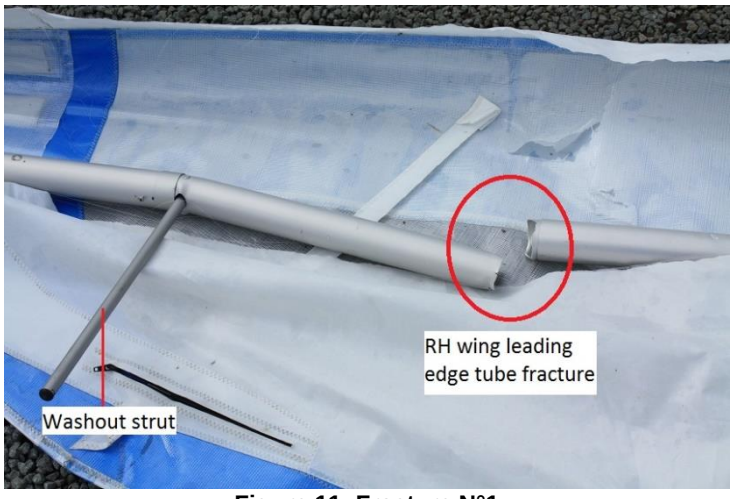



**Figure 11: Fracture N°1**

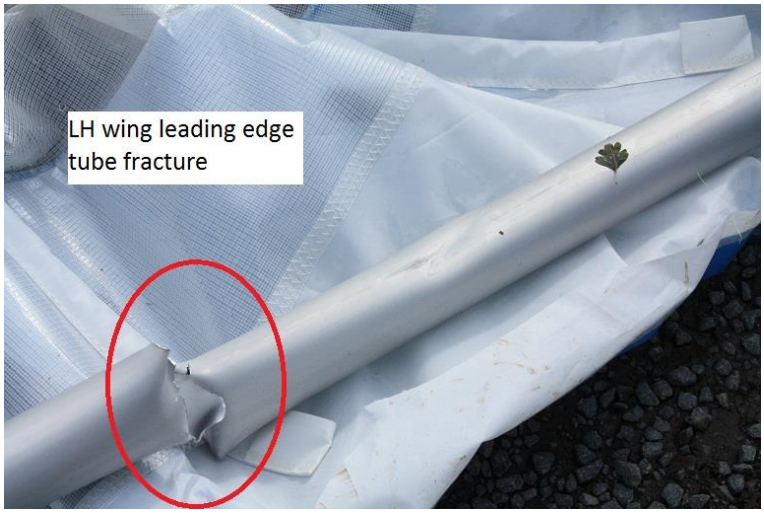



**Figure 12: Fracture N°2**

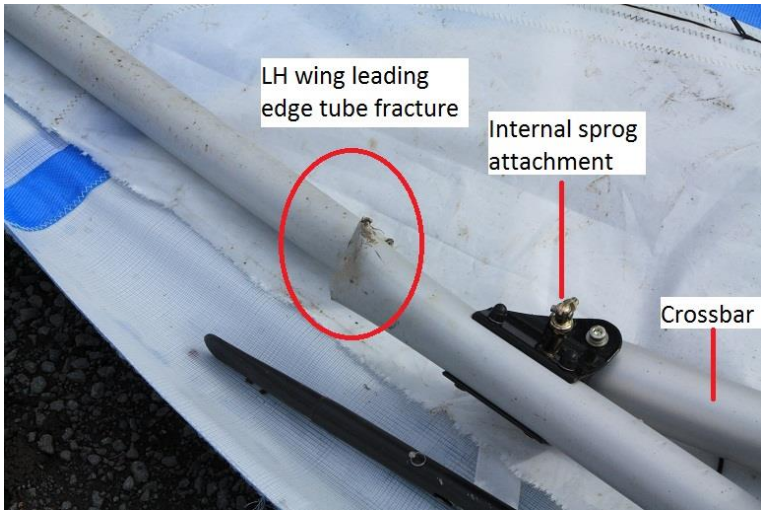



**Figure 13: Fracture N°3**

The battens.

The Battens of the RH wing were found undamaged.

The LH wing showed one fractured batten. This batten is mirroring the fracture N°2 of the leading edge tube. Additionally, some other battens were showing deformations.

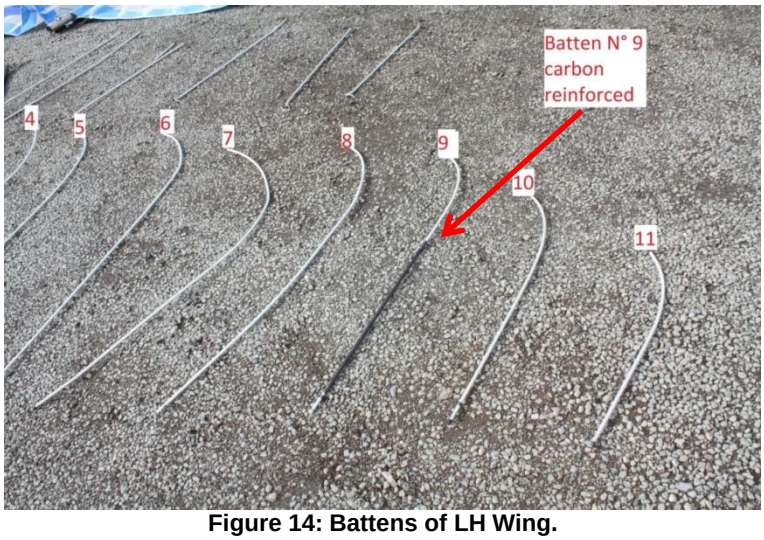



**Figure 14: Battens of LH Wing.**

Reflex system

Internal sprog fracture: The connection of the spar attachment to the internal sprog is severed, on both LH and RH sides. Both fractures are static.

**Figure 15: Internal sprog attachment area.**

Transversal rods:

The transversal rods, part of the reflex system (see § 1.6 Aircraft Information), were not found in the wreckage. The transversal rod pocket was found empty. The transversal rods were found later, stored in the pilot's closet in the aero club building.

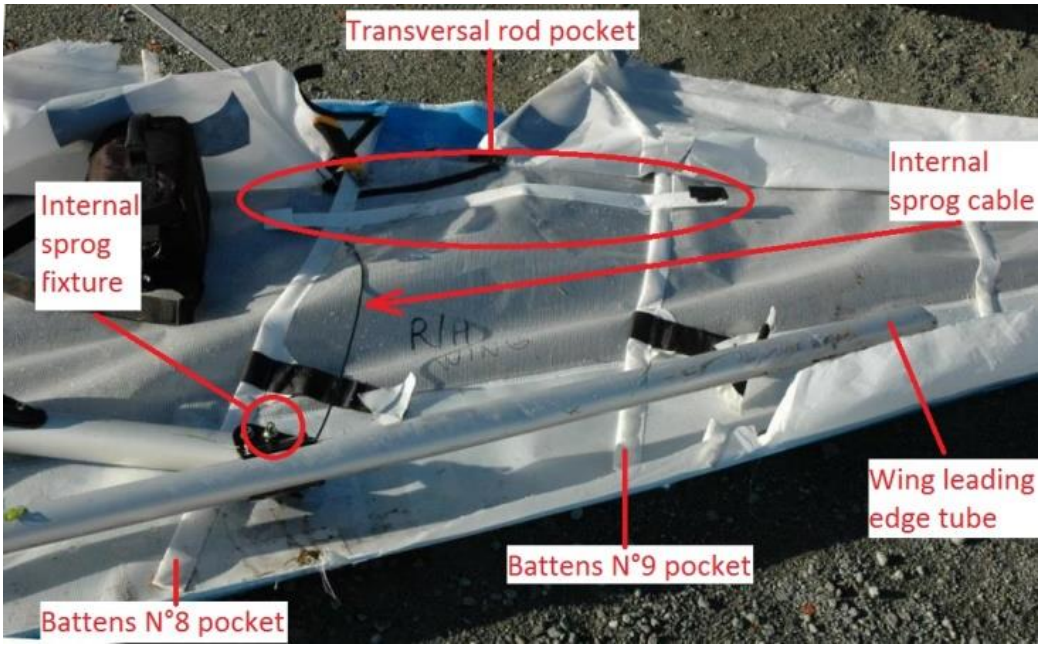



**Figure 16: Empty transversal rod pocket**


**Figure 17: Transversal rod found later in the owner's closet.**

Flight Controls

The control bar was almost intact, showing little deformation. The LH down tube was broken near the upper connection and in the middle. The LH side strut was severed just aft the connection with the control bar and damaged near the connection with the Leading edge tube.
The tensioning cables were undamaged and still attached to the wing keel.

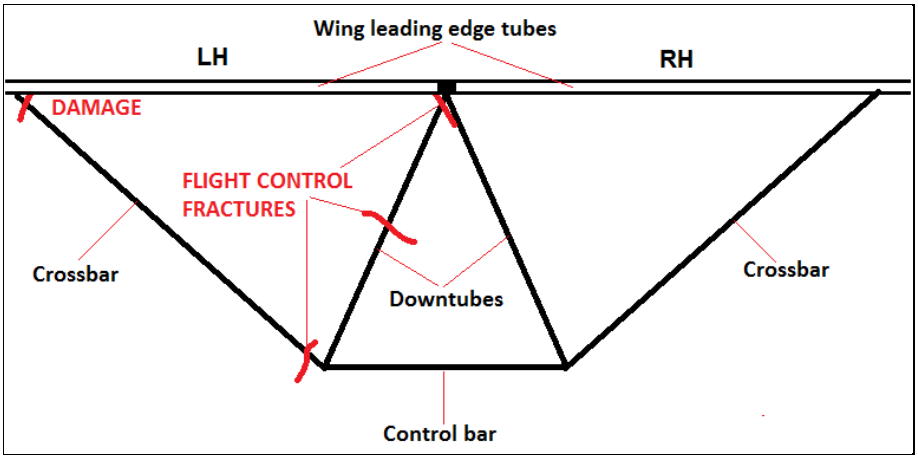



**Figure 18: Flight controls: damages**

The trike

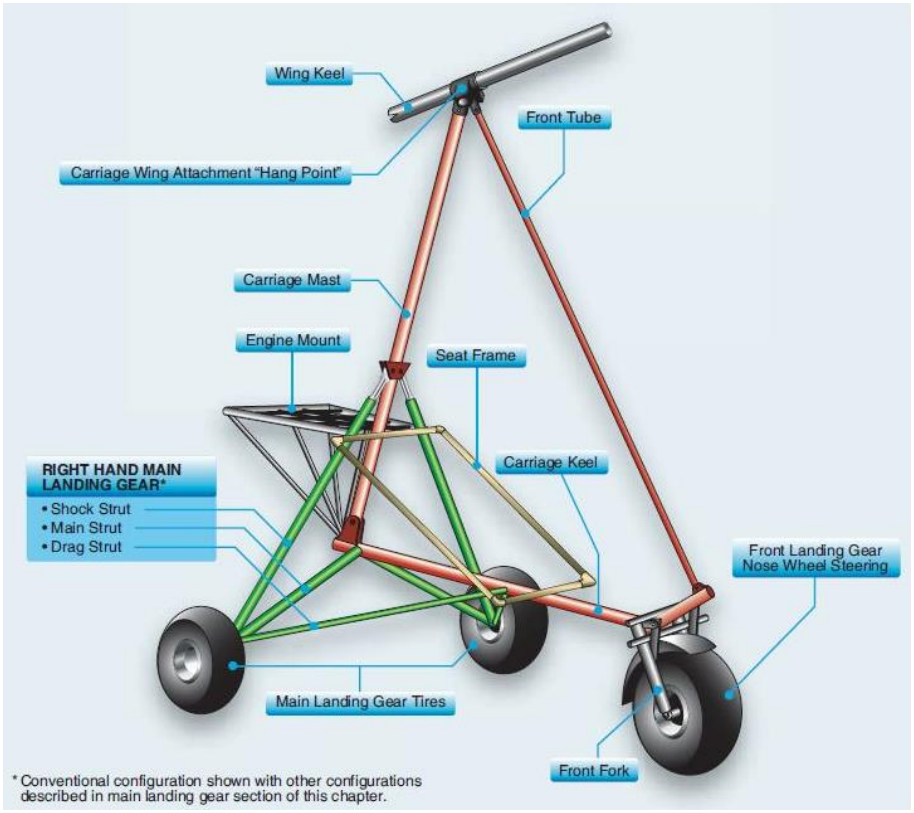



**Figure 19: Trike Components Terminology**

Hang point.

The hang point showed two anomalies;

- The fixation bolt was not secured (the safety pin was not engaged) but the bolt and its nut were properly screwed.
- The black "cube" connecting the mast of the trike with the wing keel was not limited in its longitudinal movement by a bolt or by any other fixed device as foreseen by the trike manufacturer. A rope strapped around the keel worked as a provisional forward stop, reducing somewhat the black cube forward movement. However, a movement of a few centimeters forward and backward was still possible between the rope and the rear stop.
  A closer inspection revealed distinctive 8cm long black traces on the keel. Other black traces were also visible on the entire length between the forward and the back stops.

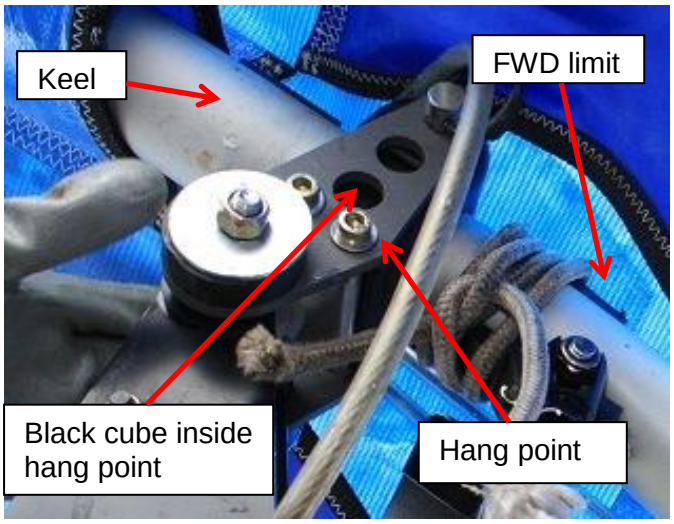



**Figure 20: Hang point**

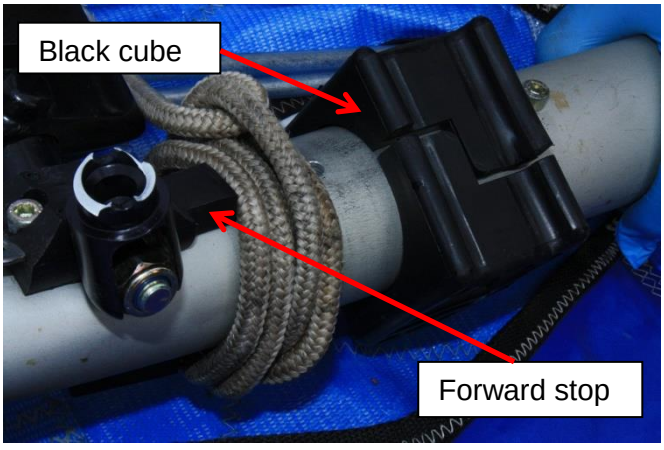
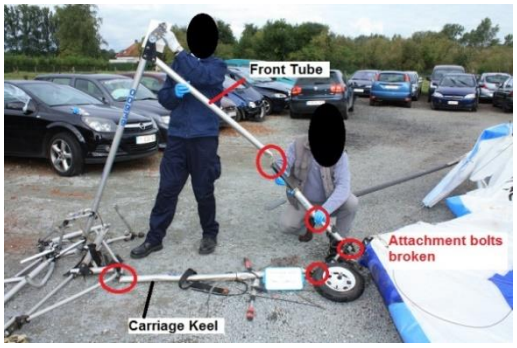



**Figure 21: Black cube is more visible after removal of the hang point.**

After removal of the black cube and moving the cord, old traces made by friction with a black cube were visible on the keel. These traces are supposed to represent the position of the hang point of the previous trike.

The trike structure

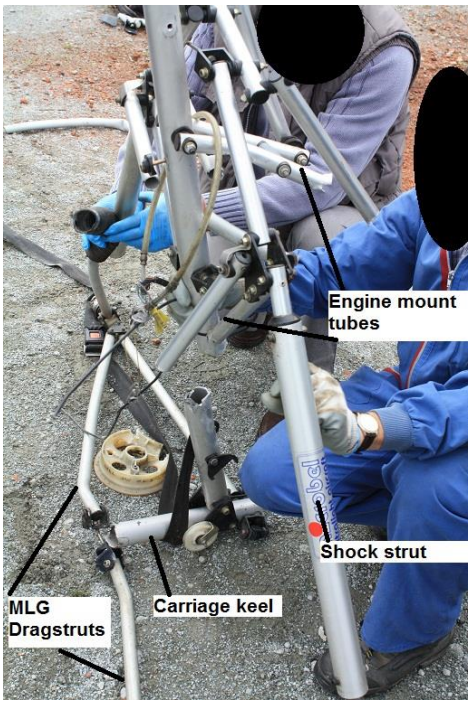
The trike had suffered a lot of damage: almost every tubes and connections were fractured. All the fractures were static and showed no evidence of corrosion or fatigue.
The front tube was severed in 2 points, as well as the attachment bolts to the carriage keel.
The carriage keel was severed at the Main Landing Gear drag strut attachment and aft of the nose landing gear.




Both feet rests of the pilot were broken in the middle (attachment to the carriage keel).

The Nose landing gear showed less damage than the main landing gear, and the damage at the MLG were concentrated on the LH side.

**Figure 22: Reconstitution of the front tube and carriage keel**




On the rear side, the engine mount tubes were broken in the attachment area.

The LH side showed more fractures and deformations than the RH side.

The safety belts attachments were broken (originally tested at 15 G).

**Figure 23: Reconstitution of the front tube and carriage keel**

The seat (safety) frame showed vertical deformations and scraping.

**Figure 24: Remains of the safety frame of the seats.**

The Engine

The engine case was fractured.

The 3-blade propeller has two blades severed at the root, and the third with damage at mid-length.

The fuel tank was still containing fuel, but was torn open.

**Figure 25: The Engine**

Engine controls

The engine throttle was set in idle.

Indication:

The speed indicator needle was found stuck at 91 km/h.

**Fig. 26: Speed indicator**

### 1.13 Medical and pathological information.

No autopsy or blood sampling was performed.

### 1.14 Fire.

There was no fire.

### 1.15 Survival aspects.

Both occupants wore their safety belts that broke on their attachment points at impact. Following the trike manufacturer, the attachment points were tested at 15 G. The violence of the impact was not survivable.

### 1.16 Additional information.

In the early seventies, at the beginning of the practice of hang-gliding, a lot of unexplained fatal accidents occurred when hang-gliders were suddenly subject to a pitch down irreversible phenomenon. The hang-gliders went in a growing nose-down and gained airspeed. At the same time the nose-down moment increased that could not be compensated by the pilot even when moving his weight back as far as possible.

This phenomenon had been studied in wind tunnels showing that the lift tends to disappear near the leading edge at low angle of attack causing the centre of lift to move back. The aft position of the centre of lift with respect to the centre of gravity made things worse, getting lower angle of attack and even negative angle of attack, beyond possible recovery.

The manufacturers of hand-gliding equipment's therefore modified the geometry of the wings and installed safety devices such as reflex lines and washout rods holding the trailing edge up during unusually low or negative angles of attack.

The problem was solved and the lessons were addressed not only for the practice of hang-gliding but also by the DPM's manufacturers. From that time, the wings had a natural tendency to return to a neutral position whatever the angle of attack.

A drawing originating from the FAA document *Weight Shift Control Aircraft Flying Handbook* (Ref: FAA-H-8083-5) is enclosed at the end of this report. This drawing shows how the reflex system affects positively the pitch stability of the sail.

# 2 Analysis.

## 2.1 Flight path

Nobody saw the aircraft in flight, except the only witness of the accident standing 650m away from the crash zone. The witness saw the DPM turning to the right and diving before crashing.

Based on the video recordings of the previous flights and on the interview of the members of the aeroclub, the pilot regularly approached the airfield at a normal altitude of around 1000ft and then used to make descending turn(s) to reach a lower altitude in final, before directly landing.

The pilot's habits, the witness declaration and the absence of pre-impact damage lead to the assumption that, as usual, the pilot put intentionally the aircraft in a steep descending turn.

## 2.2 Effects of the missing transversal rods

Questioned about the influence of the transversal rods on the wing stability, the wing manufacturer stated that removing the rods would not significantly change the inherent stability of the delta wing. However, he also insisted on the fact that transversal rods are not optional; they are integral parts of the wing.

At the end of the development process of the new wing design, the manufacturer La Mouette contacted the DULV (Deutscher Ultraleichtflugverband e.V.), a certification agency in Germany, for additional testing and certification of the wing. Intensive tests were conducted and one of the conclusions of DULV was that the presence of the transversal rods was mandatory.

Removing the transversal rods would have a small impact by decreasing the overall drag of the wing and also by improving the wing responsiveness to the pilot's commands, but at the same time it would degrade the reflex system.

The wing equipped with its rods would avoid that a nose down pilot's input could induce a catastrophic too low or even negative angle of attack.

As the purpose of the transversal rod is to artificially maintain an upward position of the trailing edge, another influence would be that a recovery manoeuvre after a dive would be slower and would require more strength to push on the control bar. Consequently the airplane would require more height to return to a level flight when the transversal rods are removed.

## 2.3 Effects of a free longitudinal moving connection of the mast on the wing keel

In normal conditions, the position of the trike with respect to the wing is defined as part of the wing/trike marriage process. The ideal position is determined during the test flights in order to achieve the best compromise between the different characteristics (Stability, speed …). The assembly wing/trike is then fixed by installing two stops on the keel beam, allowing at the same time the rotation of the black cube and avoiding any longitudinal movement of the connection.

However, the previous owner of the wing had a trim adjustment system installed. This system allows the pilot to adjust the position of the trike with respect to the wing in flight. This trim adjustment system wasn't reinstalled on the accident aircraft and it could not be determined if the new owner was aware of all the actions necessary to properly install the new wing on his trike.

In the configuration of the accident aircraft, the connection of the trike on the wing keel beam was free to move few centimetres longitudinally. Further forward movement was somewhat limited by a rope turned around the main keel.

In this configuration, the trike will be allowed to move with respect to the wing, under the influence of the forces exerted on both. It is likely that in level flight, the mechanical system will seek a balance and the configuration will not affect the flight.

By contrast, in transient operation, climb or dive, the weight and acceleration will force the trike to move forward or backward, influencing directly the controllability of the aircraft.

In a dive, the trike will move forward, inducing a supplemental nose down attitude. The strength needed to push the control bar to counteract the nose down attitude would be increased with respect to the same aircraft with an adequate connection trike/wing.

This was the direct result of the owner's decision to install another wing on the existing trike without having the necessary skills and/or without paying sufficient attention to the quality of the installation.

## 2.4 Pilot experience

The pilot accumulated a sizeable 900 FH experience flying the aircraft.

The pilot had experience combining another wing on the Microbel trike when he bought the Chronos 12.9 previously. He wanted probably to repeat the same process with the Oryx wing and was accumulating experience flying with the new Oryx wing, testing the wing. He flew most of these test flights flying alone.

The pilot was most probably over-confident in his ability to pilot the aircraft, as implied by other pilots in the aeroclub, during interviews for this investigation.

The pilot complained about the lack of responsiveness of the new wing. The new Oryx wing was not as satisfactory as expected compared to the previous

Chronos 12.9. The previous Chronos 12.9 wing has a shorter wingspan and would indeed be more responsive to inputs.

A possible explanation of the removal of the transversal rods and the makeshift mast connection could be found in the pilot's search of a better wing.

Contrasting with the evident self-confidence of the pilot, the combination of the new wing, the changes the pilot brought to the aircraft and the few flights done with a passenger has led the pilot to fly an aircraft whose reactions he barely knew.

Flight experience encompasses more than mere flying; the history of powered flights shows that the development of a new aircraft and testing a prototype require an intimate knowledge of the laws of aerodynamics.

The mixed configuration of the aircraft and the modifications brought to it show the pilot's lack of competence in this domain.

## 2.5 Hypothesis

When the aircraft approached the airfield for landing, it had to descend. The pilot brought the aircraft in a dive, in a right turn, as witnessed. The purpose was to bring the airplane at a lower height. How low cannot be determined, even though video recordings of previous flights showed some hedgehopping in the past.

The dive behaviour of the DPM most probably took the pilot by surprise, as it was steeper than usual due to the additional weight of the passenger, and the aircraft was not responding as expected.

The pilot initiated a pull up but the aircraft in this configuration could not level before hitting the ground. The aircraft was coming out of the dive but had still an important vertical speed and the altitude was insufficient to allow the pilot to effect recovery; the impact was violent (91 km/h on the speed dial).

## 2.6 Regulation

### 2.6.1 Regulation applicable to the modification of a DPM aircraft.

AR/KB dated 25 May 1999:

| |
|---|
| *Art. 26. L'aéronef ultra-léger motorisé ne peut être utilisé que s'il se trouve dans un état d'entretien tel que ses caractéristiques de base sont maintenues et s'il présente toutes les garanties d'un fonctionnement sûr.* |
| *Art. 26. Het ultralicht motorluchtvaartuig mag enkel gebruikt worden als het zich in zulke staat van onderhoud bevindt dat zijn basiskarakteristieken behouden blijven en het alle waarborgen vertoont voor een veilig gebruik.* |

Article 26 means that the DPM aircraft may only be used if it is properly maintained in such a way that its basic characteristics are preserved and a safe working is guaranteed.

The replacement of the wing by a new type is not strictly speaking a maintenance operation. However, the poor integration of the keel/mast assemblies and the subsequent alteration of the new wing could not assure that a safe working was preserved.

Extract of Circulaire / Omzendbrief CIR-AIRW-12 pertaining to modifications:

| | |
|---|---|
| 1.3 Modification<br><br>Toute modification majeure d'un aéronef ultra-léger motorisé ayant reçu antérieurement une autorisation de type doit faire l'objet d'un dossier de modification établi suivant les mêmes règles que pour l'établissement du dossier technique de base.<br>On entend par "modification majeure" toute modification qui a un effet appréciable sur les performances, la masse, le centrage, la résistance structurale, la fiabilité, les caractéristiques d'utilisation ou toute autre caractéristique qui affecterait la navigabilité de l'aéronef ultra-léger motorisé. | 1.3 Wijziging<br><br>Elke belangrijke wijziging aan een ultralicht motorluchtvaartuig waarvoor eerder een typetoelating werd afgeleverd, dient verantwoord te worden in een wijzigingsdossier, opgesteld volgens dezelfde regels als voor het technisch basisdossier.<br>Onder "belangrijke wijziging" verstaat men elke wijziging die een aanzienlijk effect heeft op de prestaties, de massa, de zwaartepuntsgrenzen, de structurele weerstand, de betrouwbaarheid, de gebruikerskarakteristieken of iedere andere karakteristiek waardoor de luchtwaardigheid van het ultralicht motorluchtvaartuig wordt aangetast. |

In case of a modification to the original configuration of a DPM, a technical file describing the new configuration must be submitted to BCAA for acceptance. Significant changes, such as the installation of a new wing type, would be subject to the examination of the technical file followed by the delivery of a new type authorization and thereafter the delivery of a new Permit to Fly (ARCA). The conditions to issue an ARCA for a DPM aircraft are defined in the Circulaire / Omzendbrief CIR-AIRW-12.

BCAA had received no file or any letter from the aircraft owner or other persons pertaining to the new configuration.

### 2.6.2 Regulation applicable to ULM airfields

Extract of Circulaire / Omzendbrief CIR-GDF-04U pertaining to the use of ULM airfields:

| *6.4 Responsabilités du commandant d'ulmodrome* | *6.4 Verantwoordelijkheden van de ULM-terreinoverste* |
|---|---|
| **6.4.2** Le commandant d'ulmodrome ou son suppléant : | **6.4.2** De ULM-terreinoverste of zijn plaatsvervanger: |
| b) est tenu de consigner et de communiquer sans délai à la DGTA toute infraction à la législation et la réglementation aéronautique, ainsi que tout incident ou tout accident survenu à l'ulmodrome selon les dispositions reprises dans la circulaire CIR/ACCID-01 édition 4 du 08/07 et (ou) toute édition ultérieure; | b) is gehouden elke inbreuk op de luchtvaart-wetgeving en -reglementering, evenals elk incident en elk ongeval dat voorkomt op het ULM-terrein op te tekenen en zonder uitstel mee te delen aan het DGLV, volgens de bepalingen vastgelegd in circulaire CIR/ACCID-01 uitgave 4 van 08/07 of elke latere uitgave ervan; |
| c) doit veiller à ce que les pilotes qui utilisent l'ulmodrome soient parfaitement mis au courant des conditions d'exploitation et des consignes particulières à l'ulmodrome; | c) moet erover waken dat de piloten die gebruik maken van het ULM-terrein perfect op de hoogte gebracht worden van de exploitatievoorwaarden en de bijzondere instructies op het ULM-terrein; |
| d) tient ou fait tenir à jour le registre des vols; | d) werkt zelf het vluchtregister bij of laat het bijwerken; |

Theoretically, the commander of the airfield should have informed the Belgian CAA of any infringement occurring at or in the vicinity of the airfield.

As reported by witnesses and seen on the video recordings the pilot had the habit of not applying a standard circuit pattern while landing in EBIS. Instead, he approached the base leg at a higher altitude and performed a steep turn descent, exiting to the final leg when the required altitude was reached.

The commander of the airfield could not ignore the numerous non-compliances with the prescribed circuit and the failure to record his flights in the airfield logbook. Despite this, the Belgian CAA never received any report coming from the airfield commander or from any other source.

Remaining silent about these events has prevented the Belgian CAA to take actions to sensitise the pilot to safety. In such cases BCAA usually sends a warning letter to the pilot involved which in most cases is deemed sufficient.

# 3 Conclusions.

## 3.1 Findings.

- The airplane was not airworthy because of the installation of another wing type. It was not complying with the type authorization originally issued for the aircraft by BCAA (ref. 94-004/10 Issue 1/13-06-2000), nor to any other known type authorization.
- The wing of the aircraft itself was modified by removing the transversal rods. This modification was not approved by the wing manufacturer.
- The modification brought to the wing had a significant influence on the aircraft's handling and performance.
- The connection of the mast on the keel beam was free to move longitudinally and was somewhat limited by a makeshift rope. This was not good practice.
- The airfield log book records show only a fraction of the flights made by the pilot with its DPM.
- The pilot log book was not properly completed. It does not show the flights performed after May 28, 2013.
- The pilot was duly qualified and licensed for piloting ULM's (DPM).
- The pilot had a wide experience flying his DPM aircraft but little experience with the aircraft fitted with the new wing including the various modifications brought to it.
- The pilot regularly approached the airfield making steep descending turn(s) to reach a lower altitude in final before directly landing. This was a non-compliance with the applicable circuit pattern of EBIS airfield.
- The aircraft crashed when approaching the airfield for landing.
- There was no pre-impact failure of the structure or flight controls on the aircraft.

## 3.2 Causes.

The accident was caused by a loss of control further to a steep descent manoeuvre initiated by the pilot before landing. It is likely that the pilot was surprised by an unexpected behaviour of the aircraft caused by the poorly performed and unapproved aircraft modifications.

**Contributing factor**:
The repetitive non-compliance with the applicable circuit pattern of EBIS airfield was not reported to the Belgian CAA as it is required by the regulation. This prevented the BCAA to have the opportunity to call the pilot to order.

# 4 Safety recommendations.

None.

# 5 Enclosure

## 5.1 Extract of FAA *Weight Shift Control Aircraft Flying Handbook* (Ref: FAA-H-8083-5).

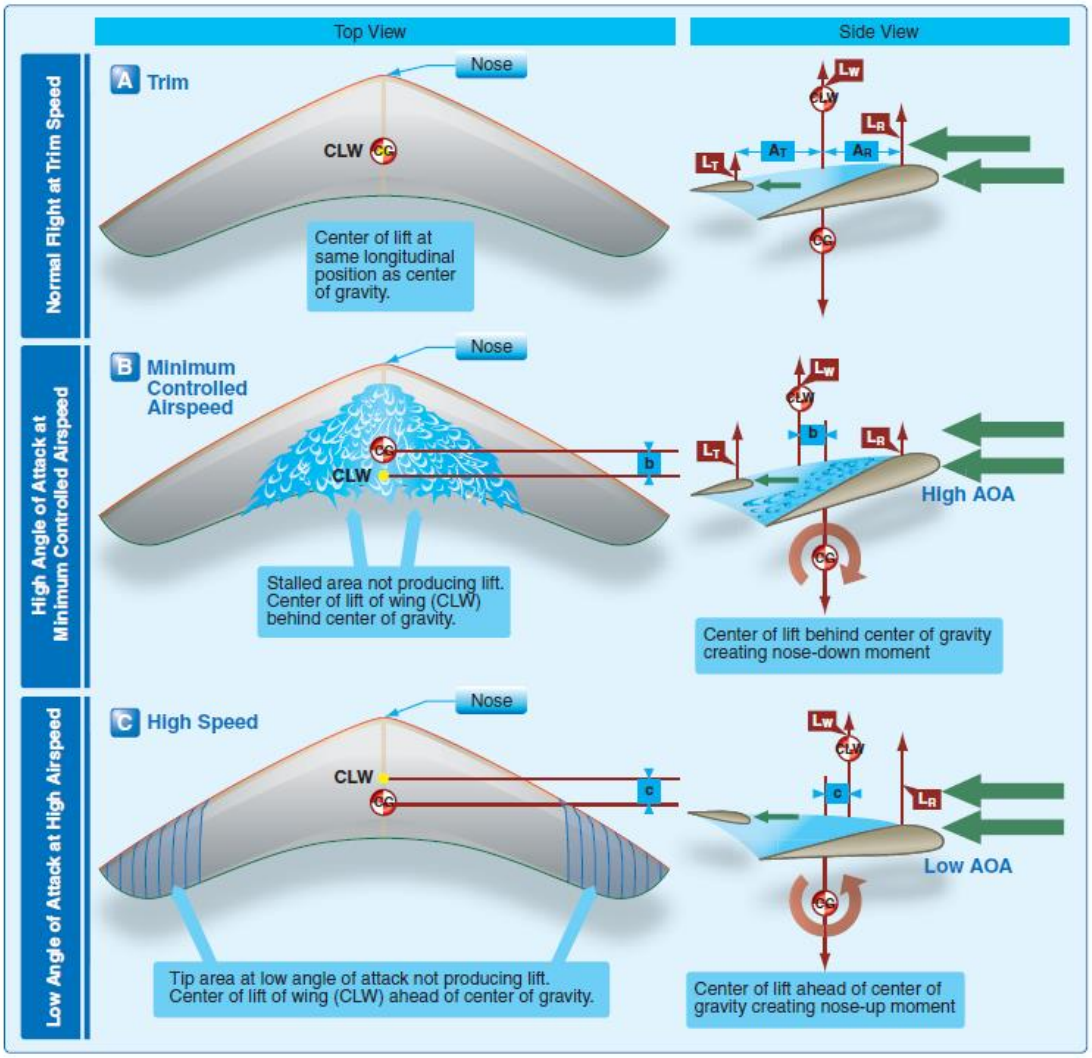



**Figure 25: Trim, minimum controlled airspeed, and high speed pitching moments.**

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