Federal Public Service
Mobility and Transport
Air Accident Investigation Unit

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- (Belgium)
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FINAL REPORT ON THE ACCIDENT TO HM 293 REGISTERED 59CKF AT EBCF ON 25 APRIL 2011

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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 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 and S. Laureys.
The report was verified by L. Blendeman

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

SYNOPSIS

Date and hour of the accident:	25 April 2011 at 9:00 UTC
Aircraft:	ULM : “Henri Mignet” HM 293
Accident location:	EBCF Airfield
Aircraft owner:	The pilot was the owner
Type of flight:	Local flight
Persons on board:	1

Abstract:

At the end of a local flight the aircraft landed on the Cerfontaine airfield (EBCF). The landing was smooth by touching the ground first with the main landing gear followed by contact with the nose landing gear.

When the nose landing gear touched the ground, the nose wheel / fork assembly collapsed and was projected in front of the airplane in a rebound movement.

Immediately after, the nose landing gear leg contacted the ground and as a consequence the airplane slowed down abruptly and flipped over.

The airplane was severely damaged and the pilot was injured.

1 Factual information.

1.1 History of flight.

The pilot wanted to make a local flight early in the day to benefit from the very quiet wind in the morning.

This flight was the second test flight after repairs that followed an accident during take-off in November 2010.
The first test flight had shown that the original nose landing gear fork axle was slightly bent and had to be replaced.
The second flight was performed after the replacement by a homemade similar part.

The pilot went to the airfield at 6:30 UTC and prepared the aircraft for the flight by deploying the wings and making a pre flight inspection.

He took off from runway 30 around 8:15 without any problem and made a local flight of about 45 minutes.

At the end of the flight he made a first approach to runway 30 when he realized he was too high and decided to go around and to repeat the approach.

The second attempt to land was stable and under control and the airplane landed at around 150 meters beyond the threshold.

Witnesses reported that the landing looked normal.

The main landing gear first touched the ground followed by a small rebound. At the end of the rebound, the main landing gear again touched the runway gently followed by the nose landing gear.

The nose wheel and fork assembly separated from the landing gear leg immediately when the wheel contacted the ground.

The nose wheel and fork assembly was seen by witnesses to fly in front of the airplane in a parabolic rebound movement.

Immediately after, the front end of nose landing leg came into contact with the ground with the consequence that the airplane violently decelerated. The contact between the front end of the nose landing leg and the ground left a longitudinal 3,5 meter long track in the runway grass.

At the end of this track the engine violently hit the ground and the airplane flipped over.

The witnesses called the rescue services and ran to the crash site to help the pilot.

The head of the pilot had hit the dashboard but the pilot remained conscious and was able to climb out of the damaged airplane.

The fuel tank, upside down, was leaking through the vent hole and was also damaged by the impact force. The airplane did not catch fire.

1.2 Injuries persons.

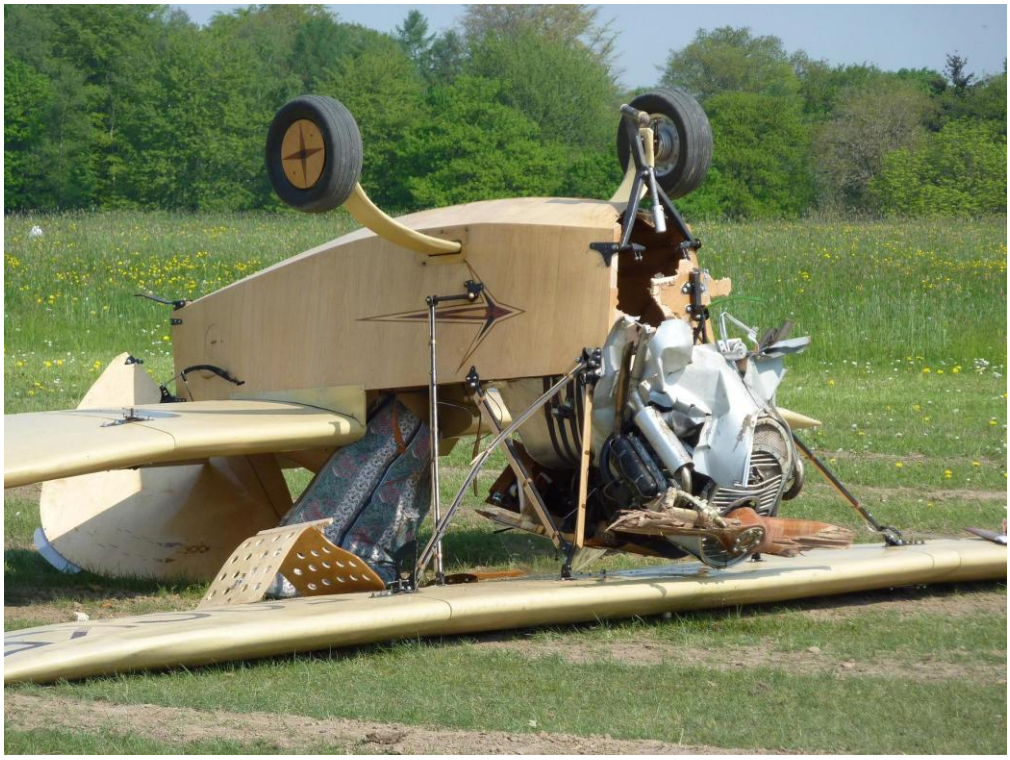
Injuries	Pilot	Passenger	Others	Total
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	1	0	0	1
None	0	0	0	0
Total	1	0	0	1

1.3 Damage to aircraft.

The propeller was destroyed, the engine was seriously damaged and the engine mount was completely crushed.

The front fuselage frame was completely destroyed and the fuel tank was pierced by the impact.

The front wings and the rudder were damaged during the flip over movement.



1.4 Other damage.

Minor damage to the runway.

1.5 Personnel information.

Pilot:

Sex:	Male
Age: years old:	48 years old
Nationality:	Belgian

License : French license for ULM (Brevet et Licence de Pilote d'ULM) delivered by the French aviation authority (DGAC) on 17 August 2006.
The pilot had at the time of the accident about 200h flight experience equally divided on Henri Mignet two-seater "Balerit" airplane for training and on its own 59CKF "Henri Mignet 293" airplane.

1.6 Aircraft information.

Airframe:

- Manufacturer: The pilot was the aircraft manufacturer.
- Type: "Henri Mignet" HM 293
- Serial number: None
- Built year: 2004
- Registration: 59CKF

- Certificate of registration: “Fiche d’identification ULM” N°A 1 03 QQ 1189 L established by the French Authority “DGAC” on 13 February 2004.
- Certificate of airworthiness: “Carte d’identification ULM” issued by the French Authority “DGAC” on 11 March 2010, valid up to 10 March 2012.
- Airplane total time: about 100h

Engine:

- Manufacturer: Volkswagen
- Type: 1600 cc
- Total flight hours: around 100h since overhaul
- Serial number: unknown

History of the Henri Mignet “Pou du Ciel” – “Flying Flea”

The Flying Flea family of aircraft was designed by French furniture manufacturer Henri Mignet.

He successfully flew for the first time his HM-14, the first “Flying Flea”, on 10 September 1933 and publicly demonstrated it in 1934. He published the plans and building instructions in “Le Sport de l'Air”, a book published the same year.

Description of the Henri Mignet “Pou du Ciel” – “Flying Flea”

Mignet made the aircraft intentionally simple.

The “Flying Flea” is essentially a highly staggered biplane, which almost could be considered to be a tandem wing aircraft, built of wood and fabric.

The original design was single-seater and had a two-axis control.

The control system is quite unconventional. The aircraft has a standard control stick. Fore and aft movement controlled the front wing's angle of attack, increasing and decreasing the lift of the wing. Because the front wing is located forward of the center of gravity this would pitch the nose up and down.

Side to side movement of the stick controls the large rudder. This produces a rolling motion because the wings both have substantial dihedral, through yaw-roll coupling. The rudder is quite large not only to produce adequate roll but also because the fuselage is very short, reducing the leverage of the rudder.

The Henri Mignet design incorporated a conventional undercarriage.

The original “Flying Flea” design being a two axis aircraft and a conventional undercarriage could not be landed or taken off in substantial crosswinds. This was not a big issue when the aircraft was designed because at that time aircraft were usually flown from large open fields allowing all take-offs and landings to be into the wind.

The “Henri Mignet” HM 293 is one of the evolution of the HM-14, also designed as a single seat A/C and usually powered by 50-60 hp VW engine.

“Henri Mignet” HM 293 registered 59CKF

Undercarriage description.
59CKF differs from the original “Henri Mignet” configuration by featuring a tricycle undercarriage. This is to allow take-off and landings with a reasonable crosswind.

The undercarriage was essentially identical to the design and the drawings of another home builder of “Flying Flea” (Philippe Balligand) who developed in 1992 a tricycle design based upon the FAR 23 regulation.

Nose undercarriage repair.
In November 2010, the airplane 59CKF suffered a take-off accident when it made a runway excursion. This runway excursion happened when the wheels went into the soft marshy ground of the runway and caused the airplane to flip over.

The damages were limited and the airplane was repaired by the owner during the winter period. The repairs included the replacement of most of the parts of the nose landing gear with the exception of the nose wheel fork .

After the repair the owner made a satisfactory test flight in April 2011 but he felt that the airplane had a tendency to deviate on the runway during the rolling of the take-off and the landing.

After investigation the owner came to the conclusion that the nose landing gear fork was slightly bent and should be replaced.

The owner explained that he intended to manufacture exactly the same landing gear fork axle.

To do this he went to a specialized vendor for ULM and homebuilt aircraft parts and material and asked a 20mm diameter bar of steel with 25CD4S specification.

The 20mm diameter bar of steel he requested was not available but the vendor proposed to him another 20mm diameter bar made of an equivalent material called STUB steel.

Safety belts description
The safety belts were made by the aircraft manufacturer using leather belts that the owner got from a non aviation nor automotive source.

One of the two ventral straps was provided with a fixed pin while the other ventral strap was pierced with a few holes to allow the pilot to adjust the length of the straps.

The shoulder straps were also pierced with a few holes for the same reason as above.

The holes in the leather straps were reinforced by brass eyelets.

1.7 Meteorological conditions.

As reported by witnesses: the wind was very weak and its direction was variable.
Visibility was more than 10 km and the temperature was 20° C.

1.8 Aids to navigation.

Not applicable

1.9 Communication.

A normal radio communication was established between the airplane and the airfield EBCF Flight Information Service.

1.10 Aerodrome information.

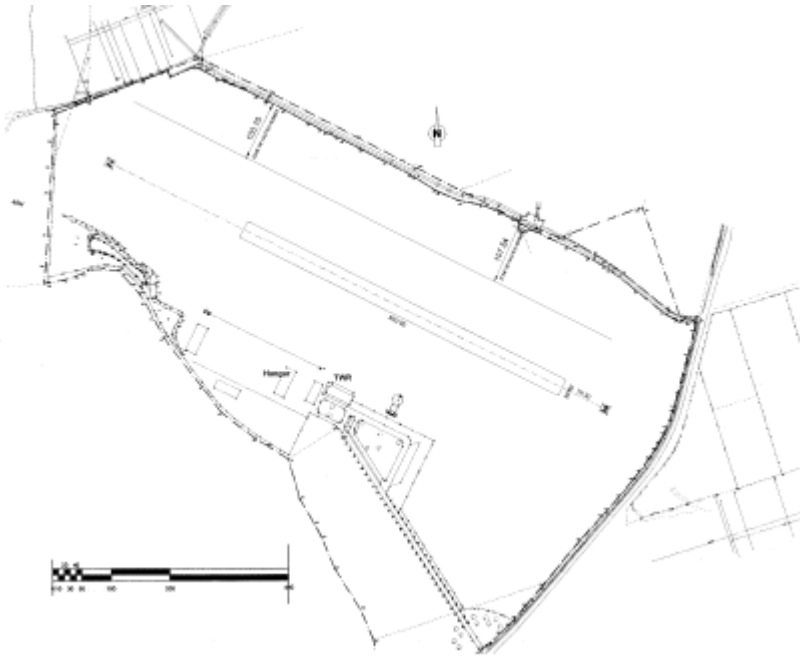
The airfield of Cerfontaine EBCF is located N 50°09'10" – E 004°23'14", at 2,7 km south of the city of Cerfontaine (Belgium - Province of Namur).

The elevation is 955 ft (291m) and it is equipped with a 600 m long – 30 m wide grass runway oriented 117° / 297°. Maximum strength is 5700 kg.

This operator is “EBCF S.A.” and the use of the airfield is subject to prior permission from the operator.

The circuits are left hand for runway 30 and right hand for runway 12, at an altitude of 1000 ft AGL.

The aerodrome is provided with a Flight Information Service (AFIS) called “Cerfontaine Radio” on the frequency 125.875 MHz (Information only, no ATC).



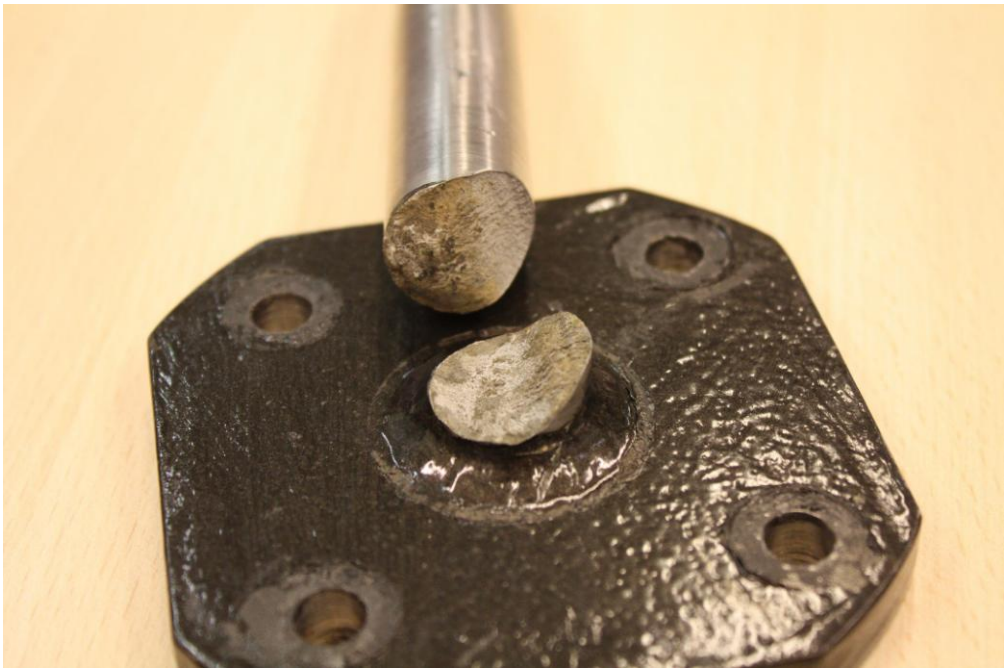
1.11 Flight recorders.

Not applicable

1.12 Wreckage and impact information.

The airplane nose landing gear leg left a 5 meter long groove in the ground.

Then the propeller and the engine hit the ground and the airplane flipped over.



The axle of the nose landing gear fork was found broken at the junction of the square base.

1.13 Medical and pathological information.

The head of the pilot hit the instrument panel and the windshield. The pilot was injured on his face and lost at least three teeth. Moreover he suffered from concussion.

1.14 Fire.

There was a fuel leak from the fuel tank but the airplane did not catch fire.

1.15 Survival aspects.

The two leather shoulder harnesses broke upon impact at the fixing to the fuselage.

As consequence the pilot was injured during the crash when his head hit the instrument panel and the windshield.

1.16 Tests and research.

Not applicable

1.17 Organizational and management information.

Not applicable

1.18 Additional information.

Not applicable

1.19 Useful or effective investigation techniques.

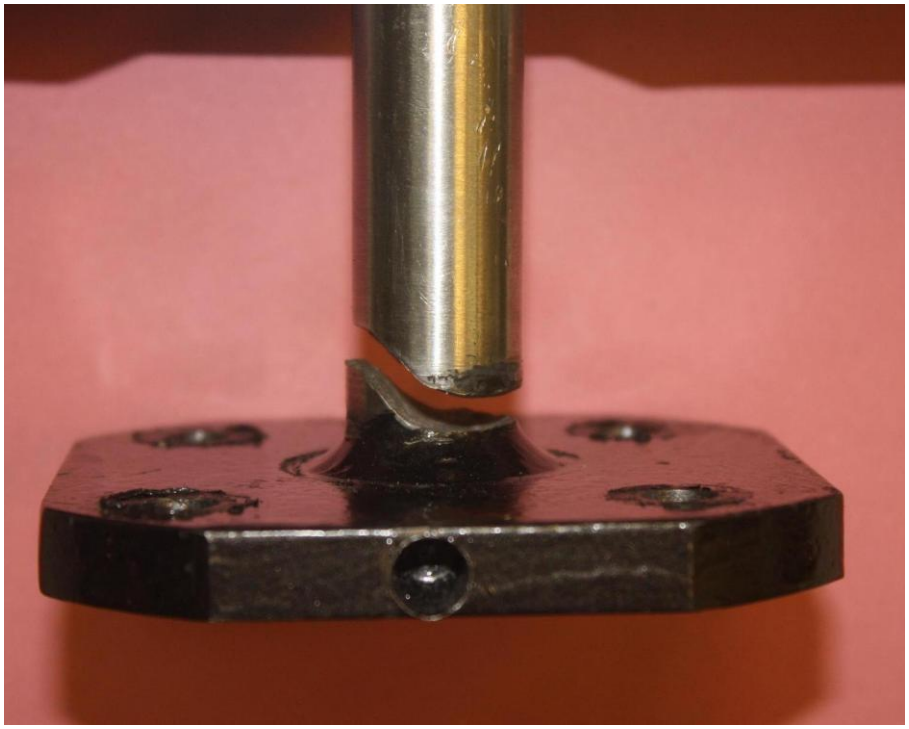
Not applicable

2 Analysis.

2.1 The nose wheel fork breakage.

Witnesses report that they saw the nose wheel and fork assembly separating from the nose landing gear leg precisely when the nose wheel touched the runway during a normal soft landing.

The nose wheel and fork assembly was retrieved forward of the wreckage and was broken close to the welding with the square base fixture of the fork.



The mechanical failure could have occurred for different reasons:

- A bad design: not likely because the old assembly that was identical withstood a lot of rolling tests and at least 100 landings without any problem. Moreover, it did not brake during the accident that happened at the end of 2010.
- A poor quality of construction: not likely because both parts, the original and the new one, were made by the owner exactly on the same way.
- Mechanical fatigue: not likely because the part was new.
- Overload due to operational reasons: not likely because all the witnesses and the pilot reported that the landing was very soft.
- Poor material: possible reason for the breakage.

Material analysis:

The owner intended to manufacture a new part using a 20mm diameter bar of 25CD4S steel while the “Philippe Balligand” design had determined that 4130 steel was necessary.

25CD4S is a French specification following the “Norme Air 9160C” while 4130 is an American specification of the Society of Automotive Engineers (SAE).

A review of both the 25CD4S and 4130 alloy composition shows that they are comparable. The owner’s material choice was therefore acceptable.

Alloying elements of both 25CD4S and 4130 include chromium and molybdenum, and as a result these materials are often referred to as chromoly steel or CRMO. They have an excellent strength to weight ratio, are easily welded and are considerably stronger and harder than standard steel.

As 20mm diameter bar of 25CD4S steel was not available at the ULM specialized shop where the pilot owner went, the shop keeper suggested him to use an equivalent product. The owner specified that he intended to weld the bar and got from this company a 20mm diameter bar of another steel material called “Stub” steel.

The owner was therefore convinced that the “Stub” steel delivered by the shop keeper was fit for the purpose he intended.

A quick review of the shop’s catalog showed that the “Stub Steel” is a commercial appellation for a steel quality close to the 100C6 specification.

Obviously the “stub steel” that the owner used to manufacture a new nose wheel and fork assembly was not equivalent to either the 25CD4S or 4130 specification and did not fit for this type of assembly by welding.

Moreover the information contained in the shop catalog clearly mentions “Very bad welding”.

The information contained in the shop’s catalog about “Stub steel” mentions some technical characteristics but does not refer to a clear official specification of material. Finally, based on the catalog nobody can determine the alloy specification and/or composition.

Extract of the shop catalog about “Stub steel”

L'acier stub est une dénomination commerciale, très proche du 100C6:
Forte teneur en carbone, + chrome et tungstène (manganèse silicium et nickel pour le 100C6)
Bon acier d'outillage, très bonne usinabilité, très mauvaises soudures.
Trempe à l'huile, à 825/875°C, revenu à 180°C.
Dureté HRC à 62 (c'est strong !)
De plus, les barres sont calibrées à +0; -2/100 en Diam et Cylindricité.
A 60 : résistance moyenne à la traction de 600 MPa (600 N/mm²)
E 24 : limite d'élasticité moyenne de 240 MPa

The pilot owner, when purchasing the part relied on the reputation of the shop and accepted the oral advise of the shop keeper. He did not verify the quality of the product he purchased (By asking for a Certificate of Conformity, or any other means).

2.2 The shoulder harnesses breakage.

The pilot wore his safety belts and shoulder harnesses.
The shoulder harnesses straps did not resist the pilot upper body inertia and broke upon impact at their fixation to the fuselage structure.

On the other hand, both the attaching points of the airplane fuselage structure and the ventral straps withstood the forces without any apparent damage.

The owner/manufacturer of the airplane did not find it necessary to install approved safety belts and did not calculate or test the resistance of the assembly.

For information, neither the French specification for ULM airplanes nor the Belgian regulation require tests or calculations 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.

3 Conclusions.

3.1 Findings.

- The airplane was provided with a valid “Carte d’identification ULM” delivered by the French Aviation Authority (DGAC). A valid “Temporary Permission to Fly above the Belgian Territory for ULM/DPM” was also granted by the Belgian CAA.
- The pilot held a valid French ULM Pilot license.
- The accident occurred when the airplane was landing for the first time after the replacement of the nose wheel fork. The nose wheel and fork assembly separated from the landing gear leg immediately when the wheel entered into contact with the ground.
- The structure of the cabin compartment withstood relatively well the impact force but the shoulder harnesses broke on impact.

3.2 Causes.

The cause of the accident is the failure of the nose wheel fork.

The failure occurred because of the use of a material that did not meet the landing gear designer specifications.

4 Safety recommendations.

Recommendation 2011-U-12 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 built or repair their ULM using only material or parts that meet the specifications of the designer.
- To verify the quality and the specification of the material or parts they acquire *(“Trust, but verify” - Ronald Reagan).*
- To install only high quality safety belts assemblies.