

FINAL REPORT

ACCIDENT
self-launching powered glider
Arcus M registration marks HB-2503,
Col Ferret, Courmayeur (Aosta, Val d'Aosta),
August 12th, 2015

OBJECTIVE OF THE SAFETY INVESTIGATION

The Agenzia nazionale per la sicurezza del volo (ANSV), instituted with legislative decree No 66 of 25 February 1999, is the Italian Civil Aviation Safety Investigation Authority (art. 4 of EU Regulation No 996/2010 of the European Parliament and of the Council of 20 October 2010). **It conducts, in an independent manner, safety investigations.**

Every accident or serious incident involving a civil aviation aircraft shall be subject of a safety investigation, by the combined limits foreseen by EU Regulation No 996/2010, paragraph 1 and paragraph 4 of art. 5.

The safety investigation is a process conducted by a safety investigation authority for the purpose of accident and incident prevention, which includes the gathering and analysis of information, the drawing of conclusions, including the determination of cause(s) and/or contributing factors and, when appropriate, the making of safety recommendations.

The only objective of a safety investigation is the prevention of future accidents and incidents, without apportioning blame or liability (art. 1, paragraph 1, EU Regulation No 996/2010). Consequently, it is conducted in a separate and independent manner from investigations (such as those of Judicial Authority) finalized to apportion blame or liability.

Safety investigations are conducted in conformity with Annex 13 of the Convention on International Civil Aviation, also known as Chicago Convention (signed on 7 December 1944, approved and made executive in Italy with legislative decree No 616 of 6 March 1948, ratified with law No 561 of 17 April 1956) and with EU Regulation No 996/2010.

Every safety investigation is concluded by a report written in a form appropriate to the type and seriousness of the accident or serious incident. The report shall contain, where appropriate, safety recommendations, which consist in a proposal made with the intention of preventing accident and incidents.

A safety recommendation shall in no case create a presumption of blame or liability for an accident, serious incident or incident (art. 17, paragraph 3, EU Regulation No 996/2010).

The report shall protect the anonymity of any individual involved in the accident or serious incident (art. 16, paragraph 2, EU Regulation No 996/2010).

GLOSSARY

AD: Airworthiness Directive.

ANSV: Agenzia nazionale per la sicurezza del volo, Italian Civil Aviation Safety Investigation Authority.

EASA: European Aviation Safety Agency.

FT: Foot, 1 ft = 0,3048 meters.

GS: Ground Speed.

IAS: Indicated Air Speed.

ICAO/OACI: International Civil Aviation Organization.

KT: Knot, nautical miles (1852 m) per hour.

LAPL: Light Aircraft Pilot Licence.

MTOM: Maximum Take Off Mass.

NM: Nautical Miles (1 nm = 1852 m).

P/N: Part Number.

S/N: Serial Number.

SPL: Sailplane Pilot Licence.

TAS: True Air Speed.

TRK: Track.

UTC: Universal Time Coordinated.

VFR: Visual Flight Rules.

VML: Shall wear multifocal spectacles and carry a spare set of spectacles.

This report has been translated and published by the ANSV for the English-speaking concerned public. The intent was not to produce a factual translation and as accurate as the translation may be, **the original text in Italian is the work of reference.**

Questa relazione d'inchiesta è stata tradotta e resa disponibile in lingua inglese a cura dell'ANSV a beneficio delle persone interessate. Benché grande attenzione sia stata usata allo scopo di offrire una traduzione accurata, **il testo di riferimento rimane quello in lingua italiana.**

All times reported in this final report, unless otherwise specified, are expressed **in UTC**, which, at the date of the event, corresponded to the local time less two hours.

ACCIDENT

Self-launching powered glider Arcus M registration marks HB-2503

Type of aircraft and registration	Self-launching powered glider Arcus M reg. marks HB-2503.
Date and time	August 12 th 2015, 12.33' UTC.
Place of event	Petit Col Ferret, Courmayeur (AO), 45°53'50.76"N 07°04'0.49"E, altitude around 2500 m.
Event Description	<p>The glider took off in towed mode from Bex airport (Switzerland) to perform a VFR flight then, coming from the Swiss territory, it impacted against the western slope of Petit Col Ferret, in Italian territory, destroying itself after contact with the ground. Both occupants died as a result of the impact.</p>
Aircraft Operator	Bex Motor Glider Association, CH.
Nature of the flight	Sport-tourism.
Persons on board	2 pilots.
Damages to aircraft	<p>The glider had a considerable level of damage, particularly the front and bottom fuselage, corresponding to the cockpit (photo 4¹).</p> <p>More specifically, the levers and arms belonging to the flight controls in the lower and lateral parts of the fuselage were heavily damaged and deformed.</p> <p>The lower fuselage was separated from the rest of the fuselage and had clear indications of scratching against grass and soil (photo 5).</p> <p>Both wings were still connected to the fuselage; the left one had minor damages (photo 7), while the right one presented impact damages on the leading edge, to about half of its length (photo 6), the final section was separated from the wing and had impact damages on its leading edge (photo 8).</p> <p>Airbrakes of both wings were in the extracted position.</p> <p>The tail boom was heavily damaged, the tail plane empennages were separated from the glider (photos 1 and 9).</p>
Other damages	No damages to third parties.
Personnel information	<p><i>Pilot:</i> Swiss nationality, 65 years old.</p> <p>SPL holder, valid.</p> <p>Radiotelephony in English/French.</p> <p>Medical certificate class 2/LAPL, valid, with VML.</p>

¹ All photos and images are included in attachment "A" to this report.

From his personal flight book emerges a total flight experience of 2056 FH on gliders up to April 21st 2015, the date of the last recorded flights. He has flown another 35h 36min after April 21st 2015 on HB-2503, hence the total flight experience on glider is not less than 2092 FH.

In the 12 months prior to the accident, he had flown 56h 37min on HB-2503.

In some of the flights recorded on his personal flight logbook, he reported to fly over Col Ferret. At the time of the accident he occupied the front seat and was wearing a flight suit.

Pilot: British nationality, 66 years old.

SPL holder, valid.

Medical certificate Class 2/PPL, valid.

His total flight experience on gliders was approximately 1020 FH.

In the year prior to the accident, he had flown 68 FH on HB-2503.

At the time of the accident he occupied the rear seat and was wearing civilian clothes.

The autopsies carried out established that the death of both pilots was caused by poly trauma resulting from the glider impact, which was mainly thoracic and artuvial for the front seat occupant, cervical-thoracic for the rear seat occupant.

Toxicology exams have excluded that both pilots could have taken substances capable of interfering with their ability to fly.

Aircraft and engine information

The two-seater self-launching powered glider Arcus M, built by Schempp-Hirth Flugzeugbau GmbH, has a 800 kg MTOM, a 20 m wingspan, it is equipped with a 70 hp Solo 2625-02i engine; engine and propeller are retractable and storable inside the fuselage during flight.

The glider stall speed, in level flight, with no flaps and without load factor, is 87 km/h; 103 km/h with a bank angle of 45°.

The best L/D (or best glide ratio) speed is 110-130 km/h, without flaps and a mass around 750 kg (presumable HB-2503 weight at impact).

The accident glider (S/N 079) was configured to be piloted from both front and rear seat.

The glider documentation found on board was valid.

According to the glider Journey Log Book, where last recorded flight was on July 28th 2015, it appears that the glider had accumulated, from new, about 283 FH of total flight time.

On July 21st 2014, HB-2503 was sent to the manufacturer due to engine malfunction (at engine hours 12.49⁷) and other minor repairs and replacements.

At the end of the repair and maintenance works, the glider underwent a check flight with positive results and released to service on July 31st 2014.

On July 30th 2015, a certified operator carried out the 25h engine check.

From August 8th 2015 the engine was out of service, on the day of the accident the HB-2503 performed a towed take-off.

Information on the place of the event

The glider impacted the western slope of Petit Col Ferret, in Italian territory, about 200 m from the Swiss border. At the point of impact the slope is quite steep (about 35° of inclination) and the ground is mainly made of grassy and rocky areas, with outcropping rocks.

Meteorological information

Weather information have been acquired through:

- the Italian Air Force weather service;
- the regional weather service (Pré de Bard and Mont Botzalet weather stations);
- witnesses declarations;
- wind data recorded by the LX-9000 on-board system.

From the first three sources mentioned, it emerges that, at the time of the accident, the sky was clear, with a moderate presence of clouds near the mountain tops, an air temperature of about 18° C and wind from the North East, with sustained and variable intensity.

The LX9000 on board system, in the last 3min of flight, indicates a wind direction from 041° and an intensity of 8 km/h.

From photos of Petit Col Ferret, taken by eyewitnesses, shot at 12.24' and 12.43' (9 minutes before and 10 minutes after the accident), the area appears in full sun and substantially free from clouds (photos 10 and 11).

At the time of the accident the sun had an azimuth of 177° and an elevation of 59° (images 9 and 10).

The map relating to the quality of thermals, found on board of the glider, indicates the presence of good quality thermals in the area flown by HB-2503 (image 8).

Other information

Area of impact.

The glider impacted the western slope of Petit Col Ferret, at geographical coordinates 45°53'50.76"N 07°04'0.49"E (photo 1). At the first point of impact, parts of the front lower fuselage were buried in the ground (photo 3).

From the first point of impact, along S-W direction, there were other traces on the ground, up to the main wreckage.

Between the first point of impact and the main wreckage, several parts separated from the glider, in particular the final part of the tail and the final section of the right wing (photo 1).

The main wreckage and the other parts were transferred, hung up to a cargo hook of an helicopter of the local mountain rescue service and segregated in its hangar, located in Entrèves (AO).

Witnesses.

Information were acquired from three eyewitnesses, relatives of the victims and people on Bex airport.

The three eyewitnesses, a single person and a couple, were located, respectively, close to Petit Col Ferret and Gran Col Ferret (image 11, positions 1 and 2).

Their statements agree in having seen the HB-2503 coming from the Swiss side, flying behind the Tête de Ferret and crossing the Petit Col Ferret while turning left, towards the Dalmazzi Refuge.

The witnesses also agreed in stating that the glider was very low above the ground and that, while it was turning on the left, it hit the ground several times, then flipped over before it came to a halt.

Two of the witnesses (image 11, position 2) also declared that they saw the aircraft lowering both wings, alternately on right and left, seconds before the impact. They also added that they perceived strong frontal wind, coming from NE, once they reached the top of the Gran Col Ferret, so strong that they initially thought it could have been the cause of the accident.

From pilots' relatives and from people present at the Bex airport the day of the accident, it was possible to obtain the following information.

- The Swiss pilot sitting in the front seat had contacted, the day before the accident flight, his English friend to offer him the opportunity to take the glider rear seat for a tourist-sport flight in the "Monte Bianco" area.
- Both pilots were equipped with a parachute and an oxygen system for breathing at high altitude.
- The brother of the Swiss pilot stated that he always used to wear the multifocal glasses (prescribed in the medical certificate) and the "Bob" type blue cap during flights.
- Both pilots, before take-off, had expressed the desire to fly toward South.
- It was confirmed that the Swiss pilot knew the area of Ferret, having flown over it in the past, while the British pilot did not know the area.

With reference to the above information, it has been ascertained that both pilots, at the time of impact, were wearing the parachute, the two oxygen systems have been found near the main wreckage as well as the "Bob" type cap of the Swiss pilot; the multifocal glasses have instead not been found on the accident site.

Data recovered from the LX-9000 system.

In coordination with the judicial authorities, the two LX-9000 displays were removed from the instrument panels and then sent to the ANSV laboratories.

At the labs it was possible to download the data files, in IGC format, of the recorded flights, including the accident one.

The flight data were then sent to the system manufacturer in order to recover and validate some temporary data files.

From the data downloaded from the LX9000 system memories, recovered and validated, it was possible to ascertain the

following:

- the take-off started at 10.12'47";
- the autonomous gliding started at 10.32'12" and ended at ground impact at 12.33' (total time of 2h 0min 48seconds).

In the final phase of the flight, HB-2503 operated as follows:

- at 12.26', 7 minutes before impact, it left a thermal present on the slope to the East of Valle Combe de l'A, and then made a long flight along the North-West slope of Mount La Tsavre, maintaining a height between 2600 and 2700 m;
- about 3 minutes before the accident, it turned to the right towards the Tête de Ferret, still flying on the Swiss side, and descending to an average height between 2450 and 2500 m;
- then it made three turn, the first to the left, then to the right and the last turn to the left, to align with Petit Col Ferret (during such turn, it impacted against the West slope of Petit Col Ferret, as shown in image 1). In this last phase of flight, the GS increased from 130 to 163 km/h, with a loss of altitude of about 30 m in the last 4 seconds (images 4, 5 and 6). During the last turn, the wind direction, initially from the right, rotated and came from the glider tail (direction 041°, intensity 8 km/h).

The last recorded HB-2503 position in flight (45°53'53.59"N, 07°04'1.20"E), is about 20 m from the initial point of ground impact.

The main data related to the last recorded point are the following:

- time: 12.33' UTC;
- variometer: -3,3 m/s;
- altitude: 2446 m (QNH set to 1021 mb);
- GS: 163 km/h;
- IAS: 137,4 km/h;
- TAS: 155 km/h;
- TRK: 227°.

Wreckage investigation in the hangar.

During the wreckage investigation, carried out in the hangar where it was stored, it was considered appropriate to verify the correspondence of the crankshafts of flight controls and airbrakes to the EASA AD 2015-0140 on July 15th 2015 "Flight Controls – Air Brake Bellcrank – Inspection/Replacement", although the S/N of the glider under investigation (079) was not among those interested in the application of the aforementioned AD.

It was found that the affected components were modified according to the AD.

The crankshaft rotation pin was not found in place on the airbrake crankshaft of the left wing; the same pin and the relative bush have not been found inside the lower fuselage, which was open to the outside due to the damage cause by impact (photo 14).

In order to investigate whether the missing pin was in place at impact, the crankshaft and its support were removed, in coordination with the judicial authority, from the wreckage and sent to the ANSV laboratories for further analysis.

The airbrakes control chain was completely disarticulated from the airbrake levers in the cockpit up to the torque tube; the latter and the connection that brings the inputs to the funnel that rotates the relative crankshaft were heavily deformed (photos 12 and 13).

Analysis

Pilots.

Both pilots had a remarkable flight experience on gliders.

In particular, the pilot sitting on the front seat knew the Col Ferret area, having flown over the area several times in the recent past.

Given the configuration of the HB-2503, which allows both pilots from the front and rear seats to take control of the glider, it has not been possible to determine who of the two pilots was in control at the time of the accident; no evidence have emerged from the investigation able to provide elements to answer the aforementioned question.

Impact dynamics.

Evidence on the ground indicate that the glider initially impacted the slope with the bottom of the fuselage. No traces have been found before such point of impact, referable to ground contacts with the wings.

Parts separated from the main wreckage have been found between the first point of impact and the main wreckage, letting to assume that they came into contact with the ground after the first impact.

The conditions of the main wreckage confirmed what indicated by the ground evidence: the lower part of the fuselage and the flight control rods and linkages showed a high degree of destruction and deformation, while the wings resulted to be relatively intact.

The detachment of the external section and the damages on the leading edge of the right wing let assume that it impacted with the ground at a point following the first contact with the ground, which occurred, as already said, with the lower part of the fuselage.

The main wreckage lied inverted, position indicative of a flip over, consistent with the eyewitnesses statements acquired.

Sun position at the time of the accident.

The position of the sun at the time of impact, as previously reported, was substantially frontal (177°) with respect to the direction of the glider, with an elevation of about 59° on the horizon. It cannot be reasonably excluded that whoever was in control of the glider, may have been dazzled by the sun in the final phase of the left turn or deceived by shaded areas on the ground the glider flew over, which may have led to an inadequate evaluation of the terrain orography and/or of the real separation of the glider from the ground.

Crankshaft analysis.

Regarding the absence of the crankshaft rotation pin, it is believed that this is due to the destructive impact of the glider with the ground, in particular of the front and bottom fuselage structures, with strong involvement of the airbrakes control rods and levers.

Regarding the latter, following the impact, the pushrod to the torque shaft (image 13, detail 1) transmitted a movement in the direction of airbrakes extension to the other shaft and pushrods (image 13, details 2 and 3).

The pushrod P/N M07RG752 (detail 3) applied a downward movement to the funnel which commanded the airbrakes crankshaft, that was much higher than the one applicable by the pilot with the cockpit lever. This movement brought into contact the funnel with the oblique arm of the left airbrake crankshaft, causing the funnel deformation and the crankshaft rotation axis breakage (photos 16 and 17).

The stress received on impact was greater on the left wing flight controls chain, as suggested by the funnel deformation and loss of coaxiality between the funnel and crankshaft rotation axis on the left wing (photo 15); such damages are instead absent on the corresponding components of the right wing.

Axle and bushing were lost outside the fuselage, being the fuselage lower part separated from the remaining fuselage structures and the wreckage been transferred in flight, via helicopter cargo hook, to the hangar where he had been segregated.

The supporting elements of the left airbrake crankshaft, showed clear signs of the presence of the rotation axis (photo 18), the support bending is due to the forces applied by the impact on the crankshaft, via its rotation axis that, before the breakage, produced the supports deformation (photo 19).

Tests carried out by the manufacturer reproduced the effect on airbrakes with crankshaft rotation axis missing: at airbrake extraction, the airbrake partially and temporarily extracted, then returned autonomously in retracted position.

It was also verified that it is not possible to cause impact damages to the crankshafts parts during wing installation/removal.

Given the last flight conditions of the glider, it is very unlikely that the pilot in command could have extracted the airbrakes while the glider was very low above the ground and attempting to fly over the Petit Col Ferret.

However, assuming the airbrakes extraction in the final seconds of the flight, according to aforementioned tests conducted with the rotational axis missing, there would have been only an initial extraction of the left wing air brake, which would then be retracted autonomously, leaving only the right wing airbrake extracted.

This would have resulted in a lift and drag asymmetry between the two wings, causing a glider aerodynamic behavior opposite to the one showed by recorded flight data and reported by eyewitnesses. (left turn before ground impact).

Analysis of data recovered from the LX-9000 system.

The flight path resulting from the data retrieved by the LX9000 system indicates a gliding time of 2h 0min 48secs, with the glider flying the last thermal on Mount La Tsavre, then making a long stretch, probably in dynamic, along the West slope of the same mountain, then, with a long turn to the right, fly towards the Tête de Ferret and then towards the Petit Col Ferret.

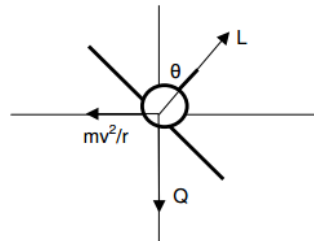
When the glider left the last thermal and started to fly along the North West slope of Mount La Tsavre, it had an initial altitude of more than 2700 m, which decreased steadily down to about 2550 m, when it made a turn right, behind the Grand Col Ferret.

In this last phase of the flight the glider made several turns, the last of which to the left to enter the Petit Col Ferret, turn only partially made, as it ended with the ground impact.

The initial impact point is about 1,5 m below the top of the slope at that point.

The aerodynamic parameters recorded in the seconds before the impact indicate a considerable amount of energy available, such to possibly avoid the glider impact with the ground.

It is not possible to have the glider attitude from the flight path elaborated by the "SeeYou" software, however, the left turn was flown at an average GS of about 135 km/h (37,5 m/s), with a turn radius around 145 m. Using these two parameters it is possible to deduce the glider bank angle in the final left turn:



Turn radius $r = 145 \text{ m}$;

average GS $v = 37,5 \text{ m/s}$;

$g = 9,81 \text{ m/s}^2$.

$$\theta = \arctg \frac{37,5^2}{145,5 \times 9,81} = \arctg \frac{1406,25}{1422,45} = \arctg 0,988611 = \sim 44^\circ$$

The left turn should therefore had been flown with a bank angle of about 44° .

The slope inclination, where the glider impacted against the ground, is around 35° ; according to the evidence on the ground, 35° should be the glider bank angle at the time of the impact, occurred with the lower fuselage and wings substantially levelled with respect to the slope inclination.

In the last 4 seconds of flight, the glider lost altitude from 2475 m to 2446 m, while passing from an IAS of 109 km/h to an IAS of 141 km/h, the latter despite a wind coming from the tail, with a direction from 041° and 8 km/h of intensity.

The loss of altitude of about 30 m occurred in the last 4 seconds of recorded flight, corresponds to an increase of IAS and TAS, as if such speeds are the consequence of a descent commanded by the pilot flying.

It should be noted that the recorded wind intensity is not consistent with the one, much higher, perceived by the eyewitnesses positioned close to the top of Gran Col Ferret.

An explanation of what stated by the witnesses could be the likely "Venturi effect", generated by the surrounding orography, able to increase, locally, wind intensity, especially during the glider flight over Petit Col Ferret.

The local wind might have generated wind rotors capable to aerodynamically disturb the glider, already very close to the ground and trying to overfly the slope, preventing the glider to gain altitude and separation from the ground.

In this regard, it should be noted that wind rotors may be more worrying depending on:

- how much is the wind speed;
- the most abrupt are the ground inclination changes;
- when in presence of irregularly shaped rocks.

For the first condition, above considerations about the wind may apply, the other two conditions were, to some extent, present in the mountain area where the glider impacted the ground.

The possible aerodynamic disturbance generated by wind rotors could also explain the wings "flapping", reported by eyewitnesses close to the Grand Col Ferret immediately before the ground impact.

The glider airspeeds in the last phase of the recorded flight was never below 110 km/h, then excludes a glider stall as cause of the loss of altitude experienced.

The left turn, flown after flying along the north side of the Ferret, put the glider on a flight path not aligned to the lowest point of the Petit Col Ferret, but with its NW slope. Such slope has a quite steep inclination and the glider point of impact is about 30 m higher than the lower part of Petit Col Ferret (photo 2).

Given the very limited separation from the ground at which the glider flown in the last seconds, it is possible to assume that the left turn maneuver could have been initiated late, also due to a non-optimal visibility of Petit Col Ferret; such delay in the left turn, could have led the glider to overfly the Petit Col Ferret not in its lower part, where it would have been easier to overcome it.

The left turn was also flown losing altitude, notwithstanding an increase of both GS and IAS: it is therefore possible to assume the pilot flying had assessed the actual glider height as sufficient to overfly the Petit Col Ferret and to reach the underlying Val Ferret.

Causes

The accident has been caused by the glider impact against the western slope of Petit Col Ferret, during a left turn, flown in

controlled flight, with the glider wings leveled with respect to the ground inclination, but with a ground separation not sufficient to overfly it.

The following factors, either alone or in combination, could have significantly contributed to the accident:

- an inadequate evaluation, by the pilot flying, of the effective ground separation, perhaps also due to the present light conditions (sun dazzling, possible ground shaded areas);
- the likely presence of wind rotors, which could have aerodynamically disturbed the glider and prevented it from gaining height to avoid the impact.

Safety recommendations

In light of the evidence gathered and analysis carried out, ANSV does not deem as necessary to issue safety recommendations.

Attachment list

Attachment “A”: documentation.

In the attached reproduced documents the anonymity of the persons involved is safeguarded, according to current dispositions regarding safety investigations.

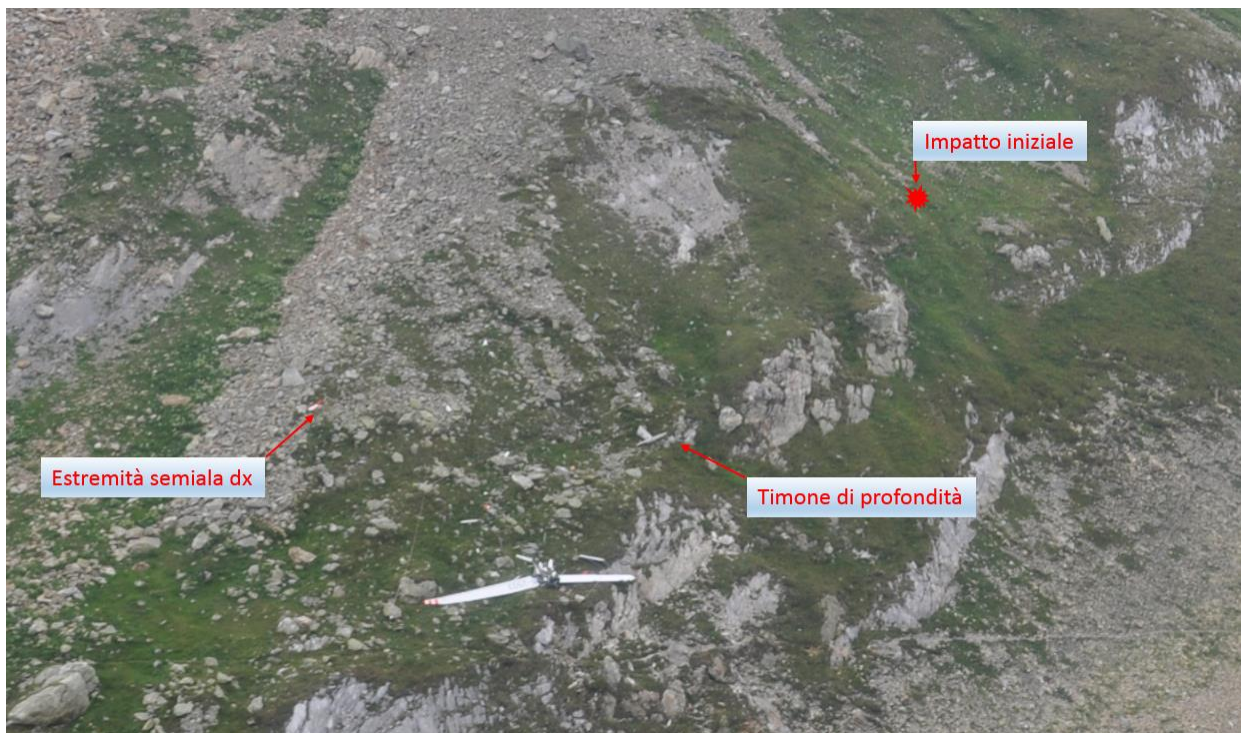


Photo 1: point of impact and wreckage distribution.



Photo 2: glider ground trajectory.

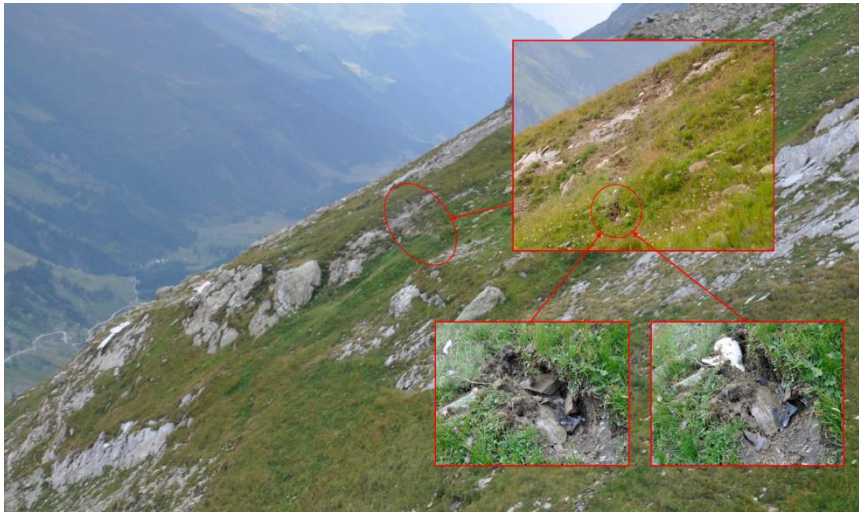


Photo 3: initial point of impact.



Photo 4: main wreckage.



Photo 5: lower fuselage.



Photo 6: left wing.



Photo 7: right wing.



Foto 8: right wing outer section.



Photo 9: tail.



Image 1: HB-2503 flight path (on Google Earth).

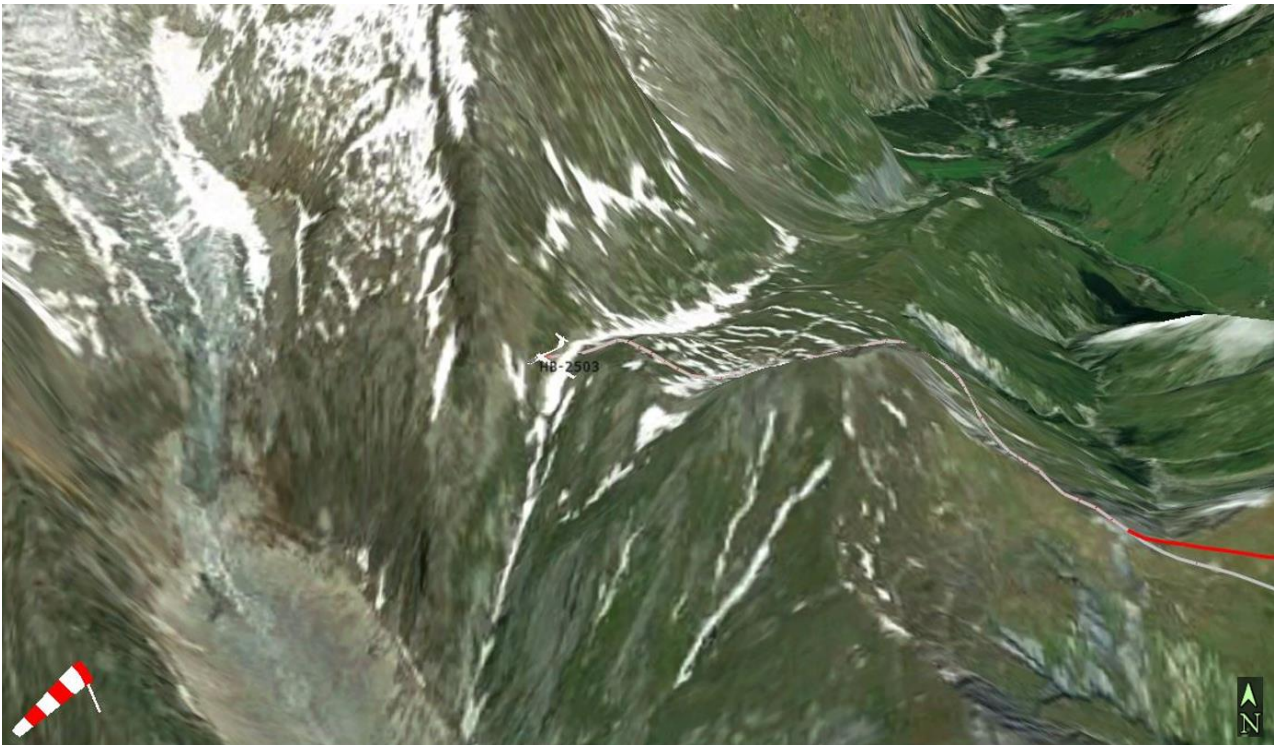


Image 2: last recorded flight position at 12.33’.

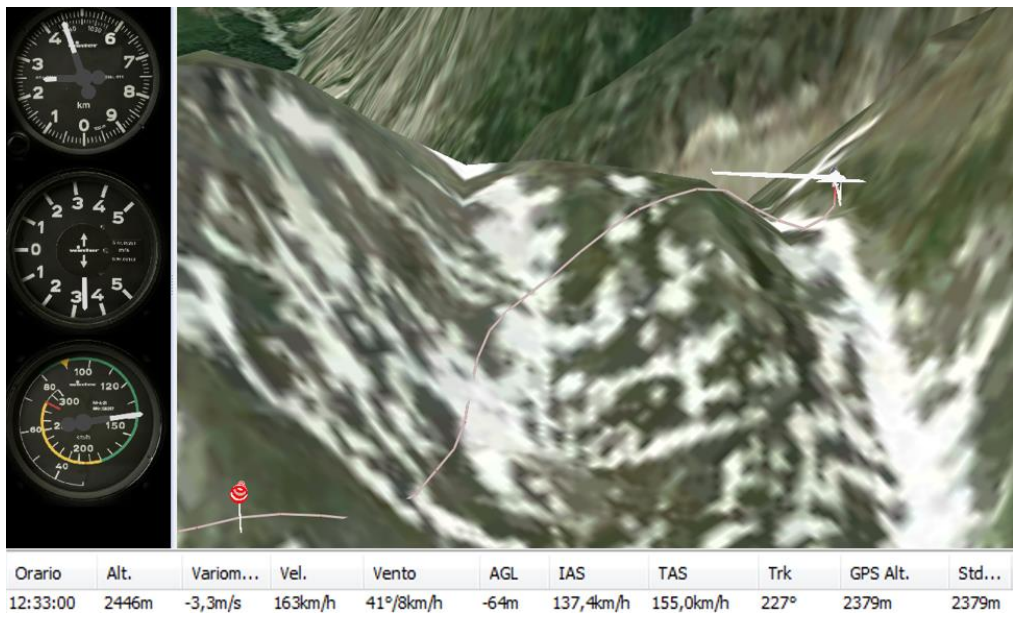


Image 3: glider rear view (from 227°) at 12.33’.



Image 4: flight data at 12.32'56”.



Image 5: flight data at 12.32'58”.



Image 6: flight data at 12.33’.



Photo 10: Petit Col Ferret at 12.24'.



Photo 11: Petit Col Ferret at 12.43'.

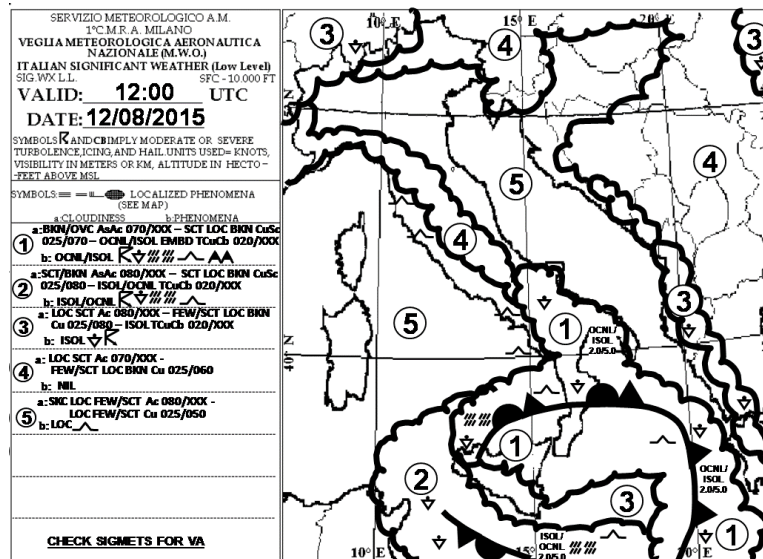


Image 7: Low Level Significant Weather.

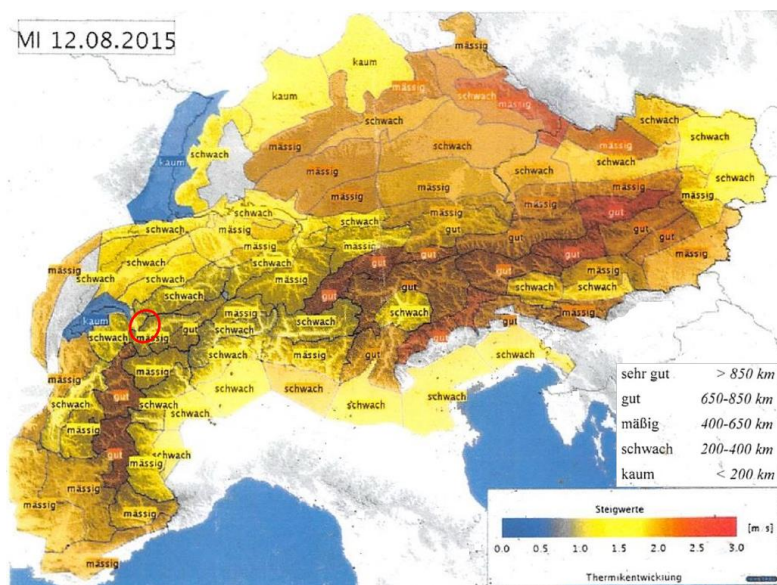


Image 8: thermal intensity forecast.

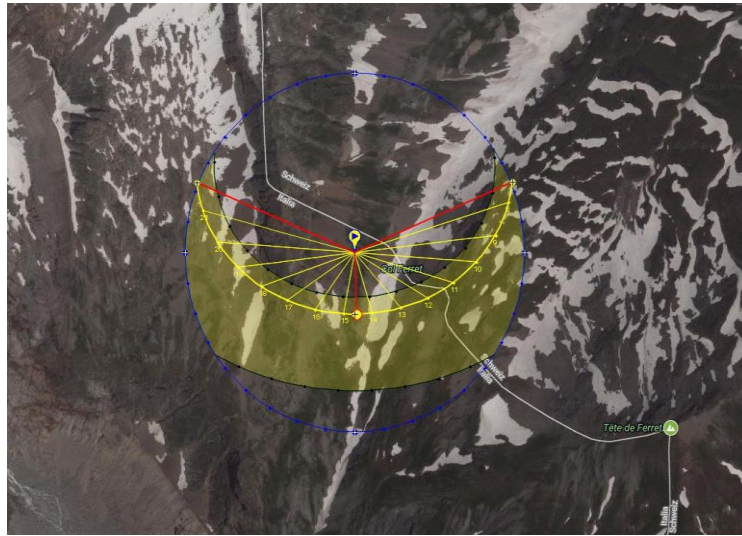


Image 9: sun position with respect to the last HB-2503 recorded flight position.

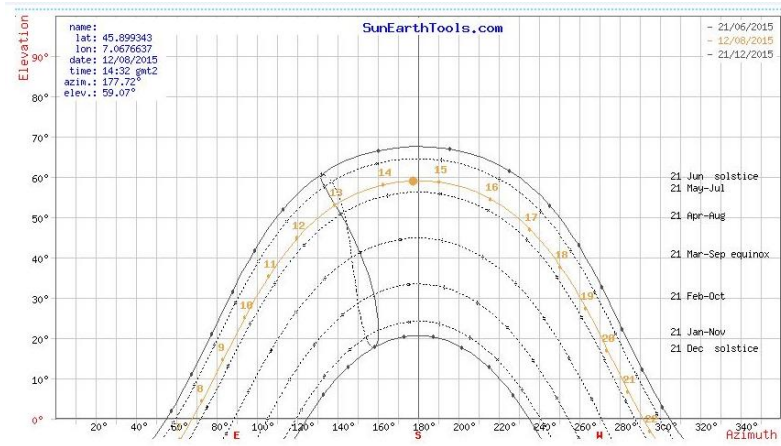


Image 10: sun azimuth and elevation.

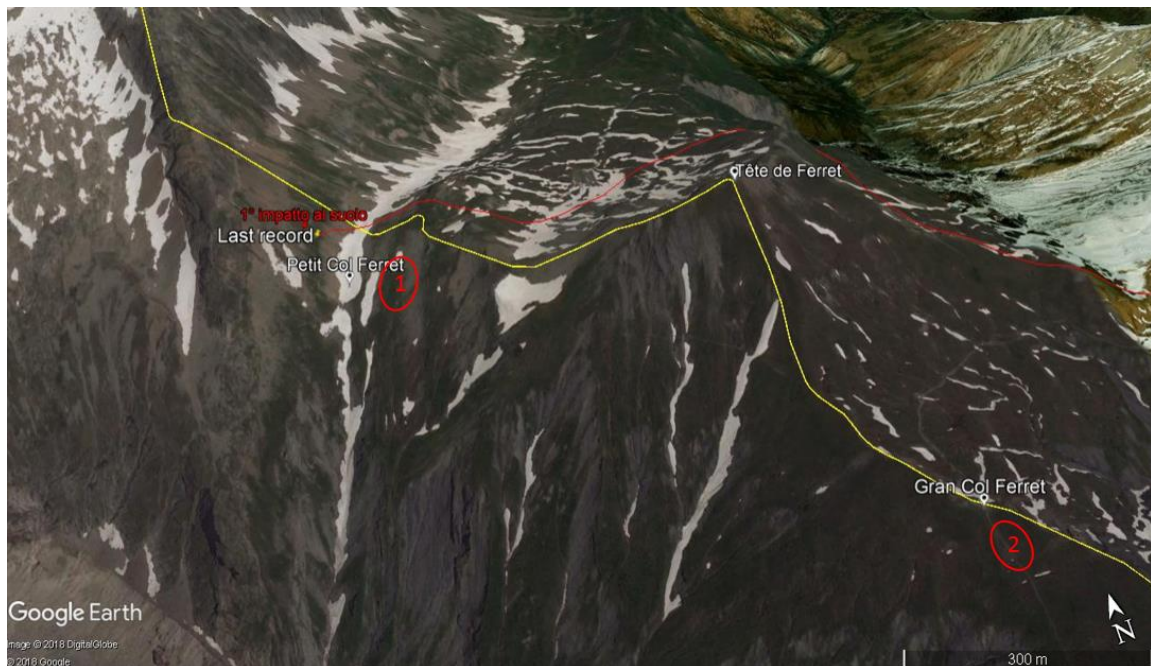


Image 11: eyewitnesses position with respect to the accident site (on Google Earth).

SCHEMPP-HIRTH FLUGZEUGBAU GmbH., KIRCHHEIM/TECK

Arcus M

MAINTENANCE MANUAL

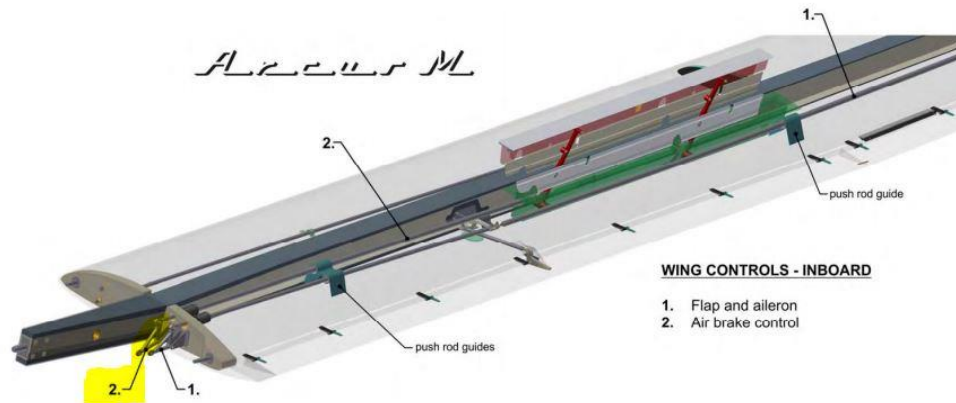
October 2012
Revision --

DIAGRAM 3a

Image 12: wing airbrakes schematic.

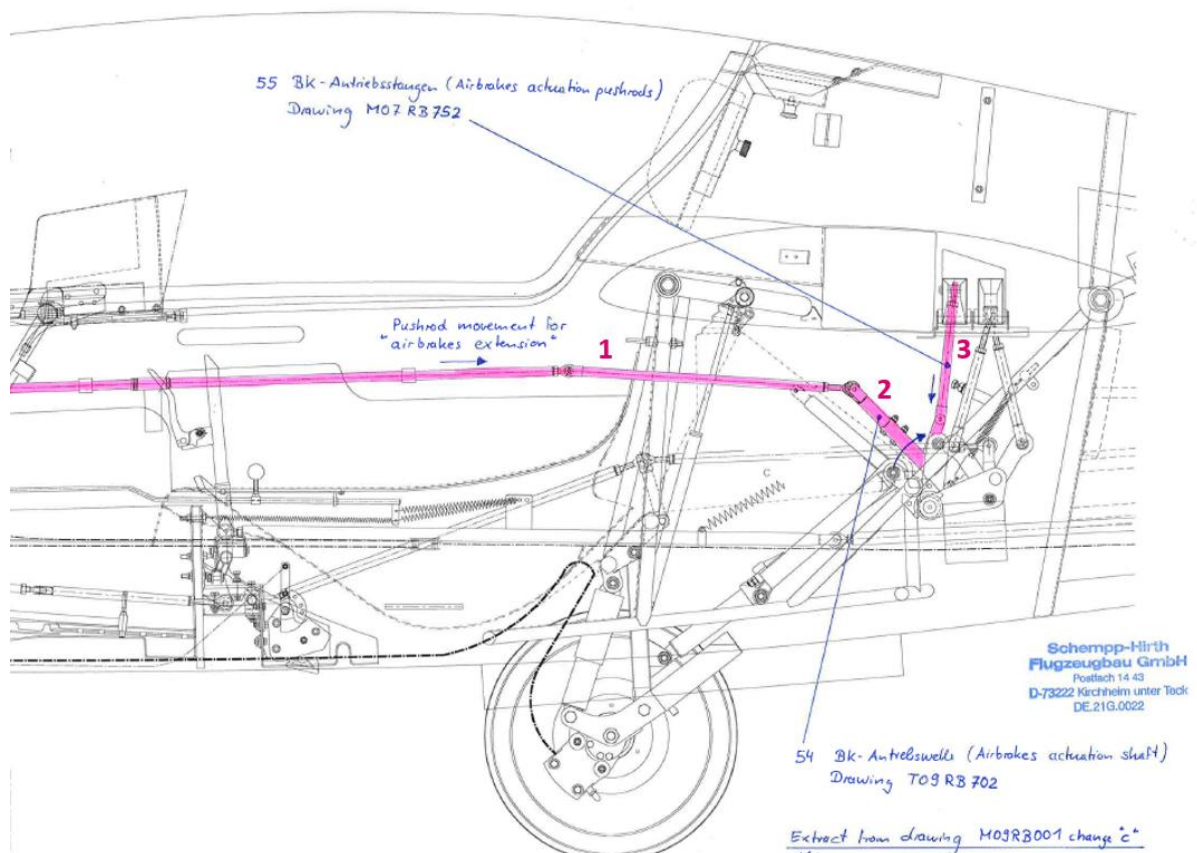


Image 13: airbrakes pushroads and shafts from cockpit to funnel (glider left side).



Photo 12: airbrakes *torque tube* damages.

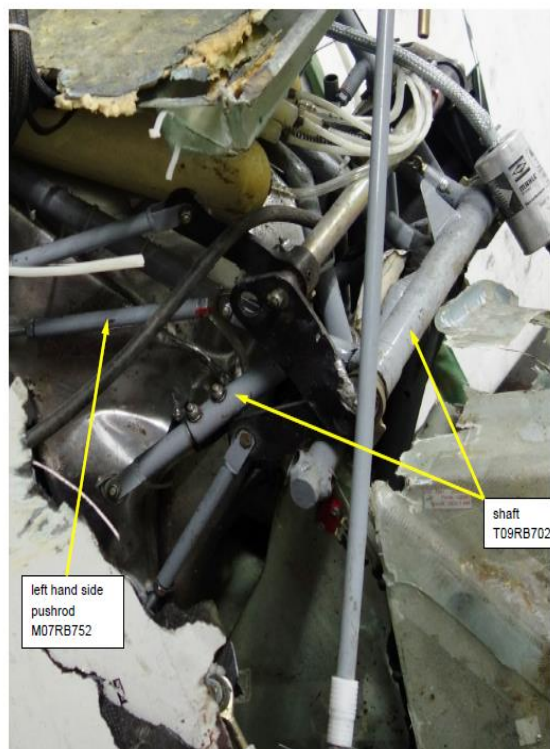


Photo 13: airbrakes pushroad and torque tube.



Photo 14: left wing airbrakes *crankshaft*, rotational axis missing.

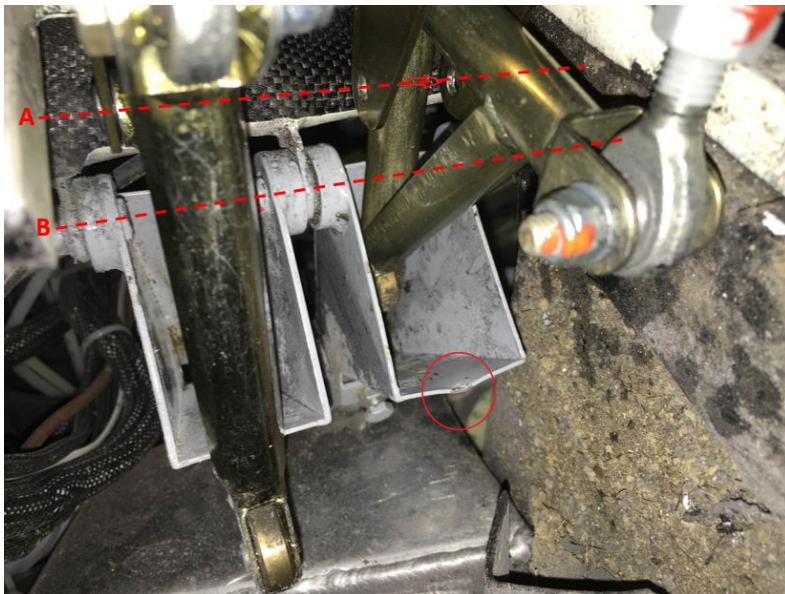


Photo 15: left wing airbrakes and flap *funnel* e *crankshaft* rotational axis misalignment.



Foto 16: left wing crankshaft *funnel* damaged.

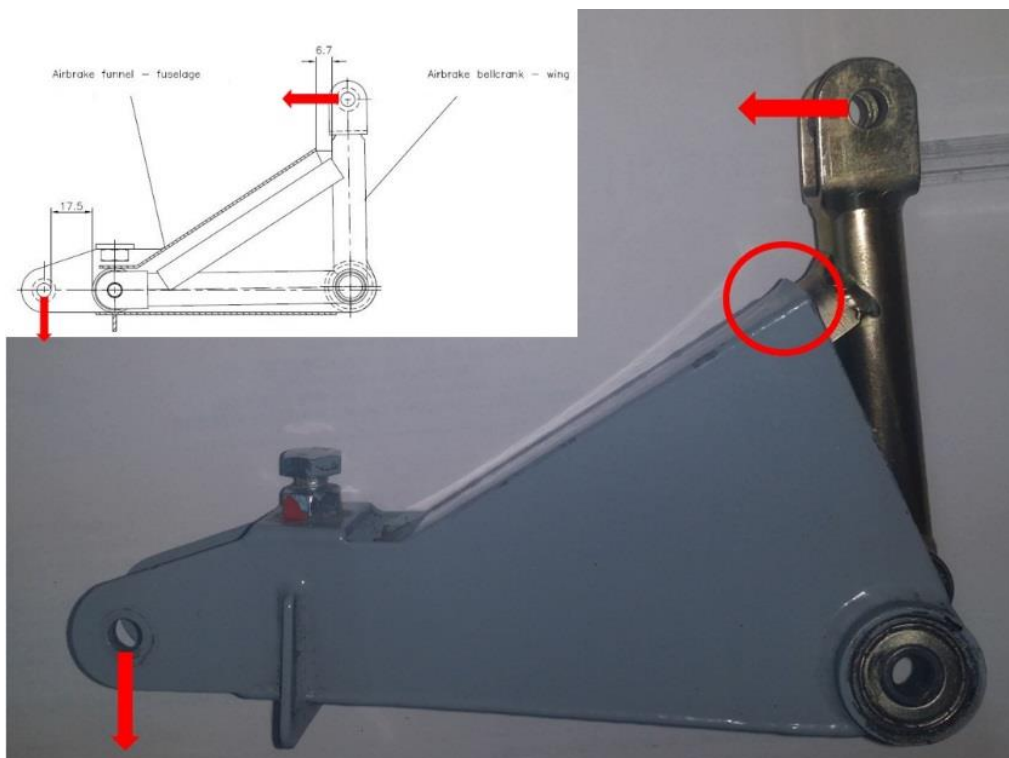


Photo 17: left wing *funnel* deformation due to contact with *crankshaft* (airbrakes extraction input).



Photo 18: traces of rotational axis on left wing *crankshaft* supports.

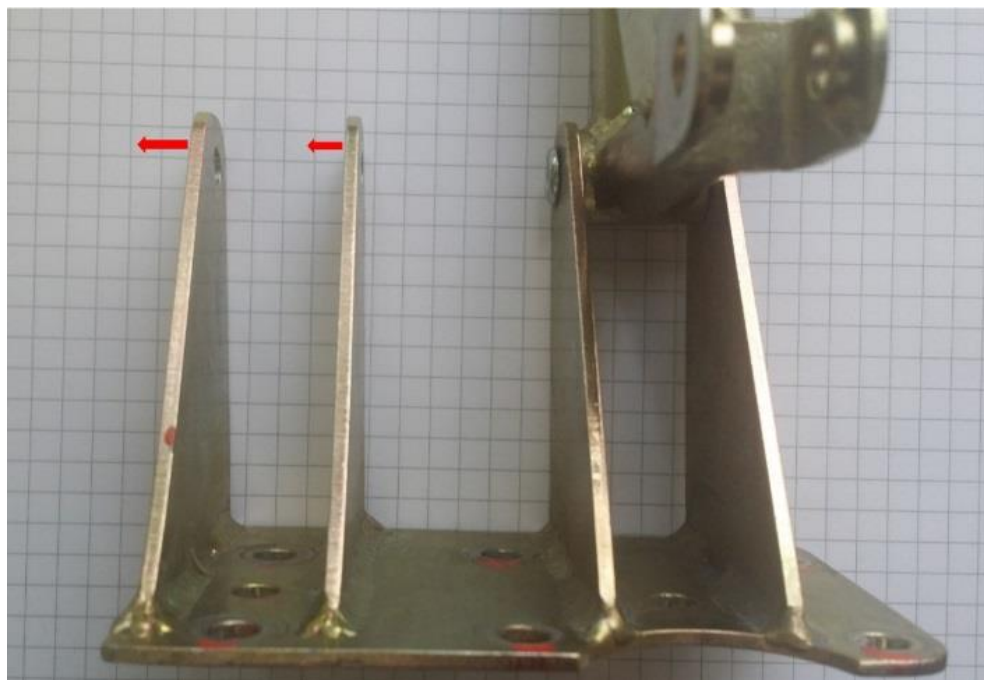


Photo 19: lateral bending of left wing *crankshaft* supports.