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Accident to the AS-06 identified 23DI on 26 May 2022 at Guéret-Saint-Laurent (Creuse)

Time	Around 17:45[1]
Operator	Private
Type of flight	Local
Persons on board	Pilot and passenger
Consequences and damage	Pilot fatally injured, passenger severely injured, aircraft destroyed
This is a courtesy translation by the BEA of the Final Report on the Safety Investigation. As accurate as the translation may be, the original text in French is the work of reference.	

Failure of the left wing in flight, collision with the ground

1 HISTORY OF THE FLIGHT

Note: the following information is principally based on the statement made by the passenger and on the statement made by witnesses on the ground, in the immediate vicinity of the accident site.

The pilot, accompanied by a passenger, took off from runway 04[2] at Guéret-Saint-Laurent aerodrome at approximately 17:30, then flew to the south of the aerodrome, where he performed steep bank turns, among other things.

It then returned to the aerodrome. He directly joined the left-hand downwind leg at low height and then made a first low pass over runway 22. After this pass, he performed a smooth pull-up manoeuvre immediately followed by a left turn. He joined the downwind leg at low height and then made a second low pass.

He repeated the sequence he did after the first pass (smooth pull-up manoeuvre and left turn at a bank angle of approximately 20°) to join the start of the downwind leg. During the manoeuvre, a clacking noise was heard, the left wing failed and the microlight suddenly lost height before colliding with the ground in a field bordering the aerodrome.

[1] Except where otherwise indicated, the times in this report are in local time.
[2] Runway 04/22 is paved and measures 675 x 20 m.

2 ADDITIONAL INFORMATION

2.1 Persons on board information

2.1.1 Pilot

The 27-year-old pilot held a microlight pilot certificate issued in 2010, along with a fixed-wing rating issued in 2010 and a gyroplane rating issued in 2013. He was granted passenger carrying privileges on fixed-wing microlights in 2011.

He also held a Private Pilot Licence - Aeroplanes (PPL(A)) issued in 2017, as well as a glider pilot licence issued in 2020.

He was a military student-pilot at the École de l'Aviation de Chasse (French school of military aviation). Since his first flight in the army in January 2020, he had logged 43 flight hours in single-engine piston aeroplanes (8 hours of which in the last three months) and 41 flight hours in gliders (none in the last three months) as part of his military duties. He was not taught low passes during his practical training at the École de l'Aviation de Chasse.

His total flight experience in civil aviation could not be determined.

He was a relative of the person who designed and built the AS-06 and who owned it. He had been the only pilot to use this microlight for two years.

2.1.2 Passenger

The 19-year-old passenger held a glider pilot licence. He had logged 194 flight hours.

2.2 Microlight information

The AS-06 identified 23DI[3] was an amateur-designed-and-built microlight, completed in 2013. It was a side-by-side two-seater, low-wing microlight with conventional fixed landing gear. It was equipped with a Jabiru 2200A engine delivering 85 hp. The investigation was unable to determine its maximum speed (VNE).

The microlight had a valid identification card at the time of the event. No major modification was declared to the French civil aviation safety directorate (DSAC).

During the accident flight, the weight of the microlight was less than the maximum weight (450 kg).

The total number of flight hours of the microlight could not be determined.

The aircraft was equipped with two diamond wings, the wooden shell of which was covered with glass fabric.

[3] The AS-06 was the only model of its kind.

The spar of each wing consisted of an assembly made of:

- square steel tubes at the lower and upper surfaces;
- two rectangular tubes and steel angles, connected to the square tubes using the brass soldering technique[4,5];
- two plywood webs bonded on the front face and rear face.

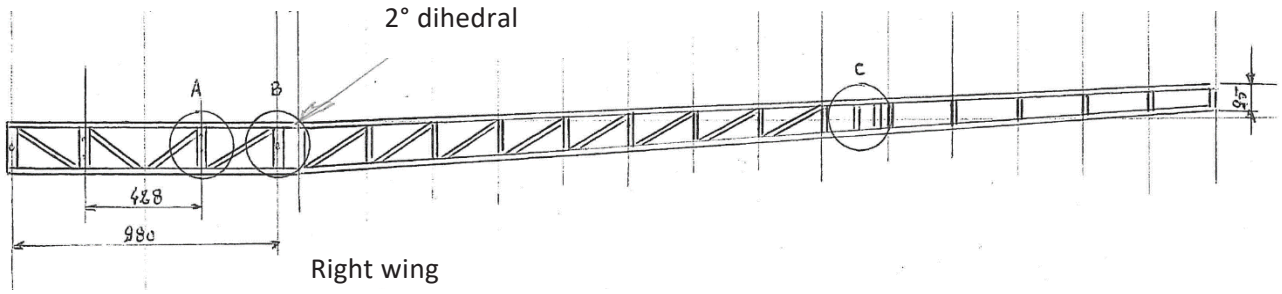


Figure 1: diagram of the right spar viewed from the rear
(Source: microlight's technical file, annotated by the BEA)

The two rectangular tubes of the left spar were used to connect it to the right spar (and to attach the main landing gear to the two spars) using two screw-and-nut assemblies. In this assembly, the left spar was located in front of the right spar (see **Figure 2**).

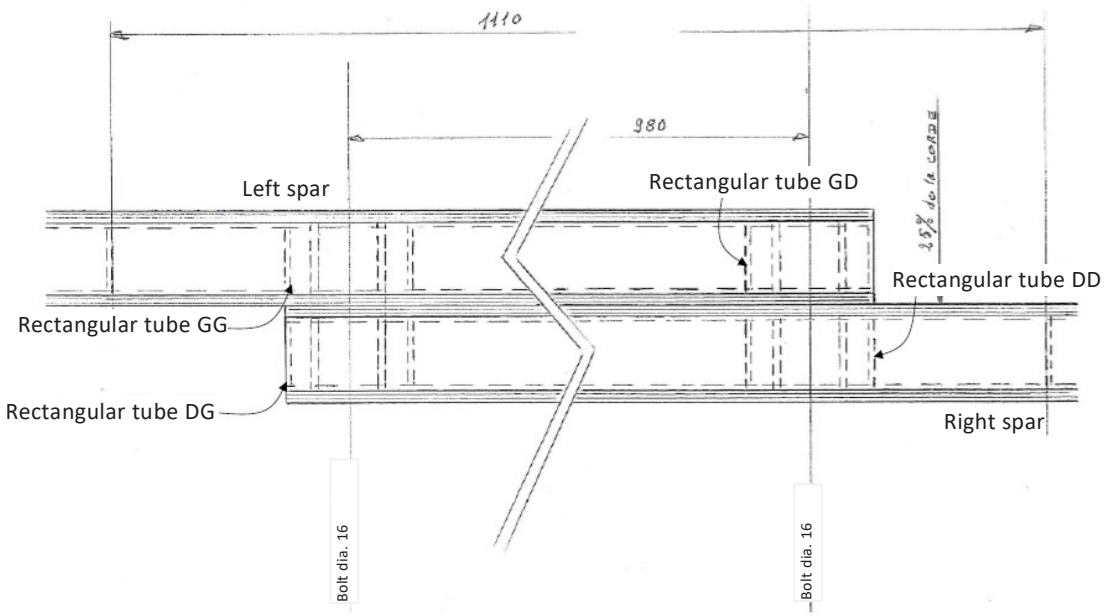


Figure 2: diagram of the assembly of the two spars, viewed from above
(Source: microlight's technical file, annotated by the BEA)

[4] Process for jointing metal parts by melting a filler metal whose melting temperature is lower than that of the surfaces to be soldered.

[5] The compatibility between the mild steel to be soldered and the brass filler metal was adequate according to standard NF EN 14324, "Guidance on the application of brazed joints".

The technical file did not include any calculations to validate the design of the microlight's primary structures.

The designer and builder of the microlight, a professional boilermaker, explained that he designed and built the AS-06 on his own and that he was unaided in this task. However, he specified that he was a member of the Réseau du Sport de l'Air[6] (RSA) in the 1990s.

The other four aircraft he designed and built had wooden spars. These were all aeroplanes with a restricted certificate of airworthiness (CNRA[7]).

2.3 Meteorological information

The meteorological conditions estimated by Météo-France at the accident site were as follows: 320° to 340° wind of 5 kt, gusts up to 9 kt, visibility greater than 10 km, 7 to 8 oktas of stratocumulus with a base at a height of 3,500 ft, temperature 17 °C, dew point temperature 11 °C, QNH 1026, no turbulence.

2.4 Site and wreckage information

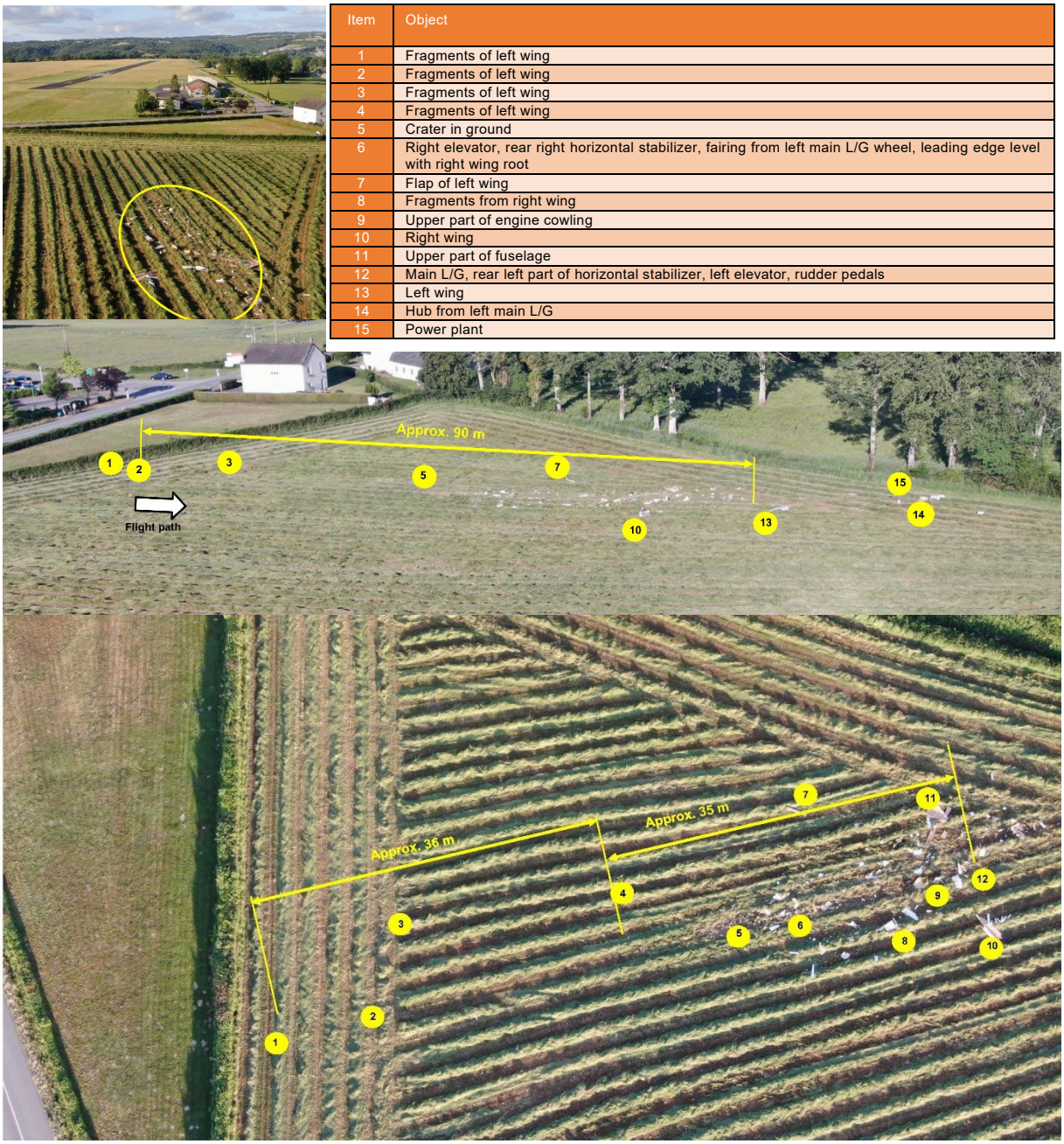
2.4.1 Site analysis

Some small pieces of debris were found in the immediate vicinity of the end of runway 22. They probably came from the left-wing root.

Other debris from the microlight was located about 200 m beyond the end of runway 22, in a field. These pieces of debris were spread over a distance of approximately 100 m, along an approximate 200° heading. The point of collision of the microlight with the ground was located at point 5 (see **Figure 3**).

[6] French federation of aircraft manufacturers and collectors.

[7] Aircraft built by amateurs may benefit from a restricted certificate of airworthiness, which provides a regulatory framework adapted to these aircraft built and operated without any commercial objective.



Item	Object
1	Fragments of left wing
2	Fragments of left wing
3	Fragments of left wing
4	Fragments of left wing
5	Crater in ground
6	Right elevator, rear right horizontal stabilizer, fairing from left main L/G wheel, leading edge level with right wing root
7	Flap of left wing
8	Fragments from right wing
9	Upper part of engine cowling
10	Right wing
11	Upper part of fuselage
12	Main L/G, rear left part of horizontal stabilizer, left elevator, rudder pedals
13	Left wing
14	Hub from left main L/G
15	Power plant

Figure 4: distribution of the microlight debris
(Source: BGTA, annotated by the BEA)

2.4.2 Examination of the wreckage at the BEA premises

2.4.2.1 General

The wreckage debris was sent to the BEA premises for further examination.

The left wing was partially reconstructed (see **Figure 5**). The metal structure of the spar was ruptured and bent backwards on the root side, which was corroborated by friction marks from the root (associated with black discolouration) on the fuselage. The two plywood webs were no longer glued.

Figure 5: left-wing root

2.4.2.2 Left spar

The left spar was fractured into several pieces (see **Figure 6** and **Figure 7**). Three failures occurred at the square tubes on the lower and upper surfaces (see **Figure 6** and **Figure 7**, points 1, 2 and 3). Several other failures occurred at the brazed joints between the angles and the square tubes. Angles marked G5, G6, G7, G8 and G9 were therefore found detached. Two angles were not found.

The two rectangular tubes of the left spar (see **Figure 6** and **Figure 7**, GG and GD) and the two rectangular tubes of the right spar were all found detached from the spars at their brazed joints, but were still attached to each other and to the main landing gear plates by the crew-and-nut assemblies.

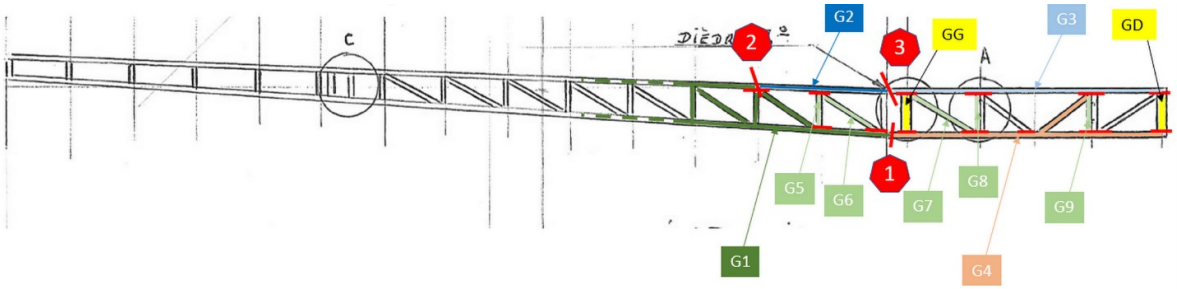


Figure 6: diagram of the left spar viewed from the rear, based on Figure 1.
Failure zones are marked in red.

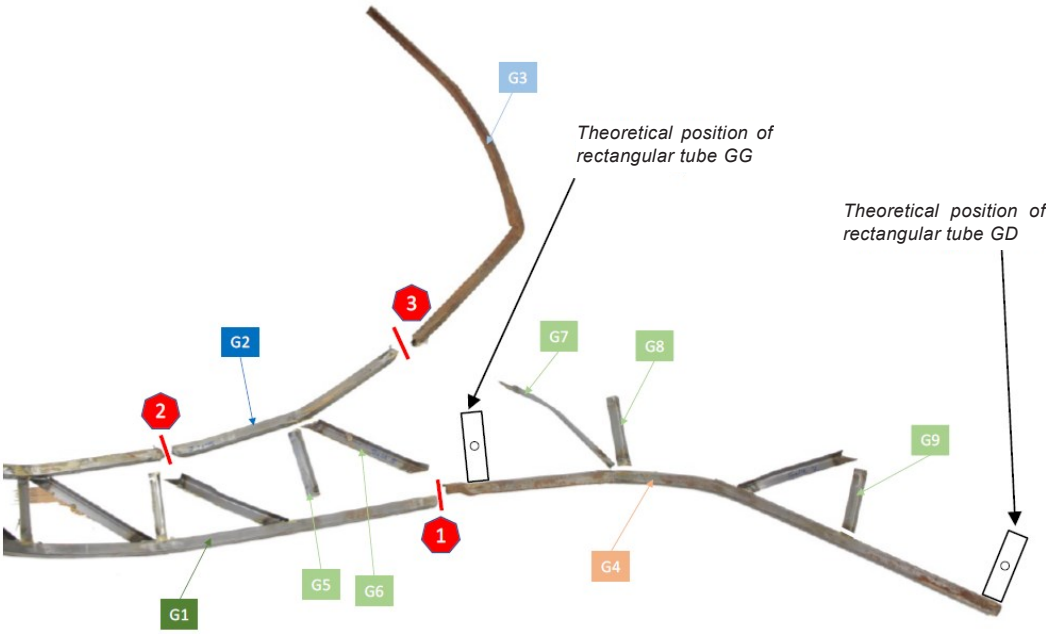


Figure 7: left spar reconstructed at the BEA premises, viewed from the rear

The brazed joints on the left spar showed many defects[8], such as misalignments between the parts to be soldered, too little or too much filler material, too much brazing clearance, or the presence of blisters.

The brazed connection between square tube G2 and angle G5 (fractured) showed signs of a progressive fatigue cracking (presence of microscopic fatigue striations).

This connection also showed a lack of brazing filler brass. As the tube and angle were detached, it was not possible to determine precisely whether there was also a misalignment or too much brazing clearance between these two parts.

The distortions observed on the spar evidenced a backward and upward movement of the left wing in relation to the fuselage. The spar showed distortions characteristic of a sudden failure under upward bending.

To summarise, one or more brazed joints between the spar components failed under fatigue. The spar could no longer withstand the stresses exerted during the flight and failed suddenly due to overload.

The quality of the brazed joints most probably contributed to the failure of the spar in flight.

[8] Similar defects were observed on the brazed joints of the right spar.

2.5 Statements

2.5.1 Passenger

The passenger explained that he made two other flights with the pilot at the controls, all local flights, at Guéret-Saint-Laurent aerodrome:

- during the first flight onboard the AS-06 in 2017, the pilot performed a low pass and turns at a bank angle of approximately 60°;
- during the second flight onboard an FFA AS 202 Bravo[9], also in 2017, the pilot performed a standard runway circuit.

According to him, the pilot performed low passes at the end of each of his flights with the AS-06.

The passenger explained that, in preparation for the first low pass over runway 22, the pilot made a turn at a bank angle of approximately 45° to directly join the left-hand downwind leg at low height. He then turned in base leg with a bank angle of approximately 45° and on final with a bank angle of approximately 60°. During the final, the approach slope was steep and the speed increased. The pilot applied full throttle at the start of his low pass over the runway and maintained a height of 20-30 m. At the end of the pass, he performed a smooth pull-up manoeuvre immediately followed by a left turn at a bank angle of approximately 20°, taking him to the left-hand downwind leg at low height in preparation for the second low pass.

The pilot then turned in base leg with a bank angle of approximately 45° and on final with a bank angle of approximately 60°. During the final, the approach slope was still steep and the speed further increased compared with the first approach. The pilot applied full throttle at the start of his low pass and maintained a height of 15-20 m with a speed which was faster than during the first pass. At the end of the second pass, he repeated the sequence he had done before (smooth pull-up manoeuvre and left turn at a bank angle of approximately 20°) to join the start of the downwind leg. The left wing failed during the manoeuvre.

2.5.2 Witnesses at the aerodrome

According to two witnesses, the pilot performed a local flight onboard the AS-06 which lasted just over ten minutes earlier in the afternoon. Alone on board, he made two low passes over the runway.

All the witnesses stated that the left wing remained attached to the microlight until it collided with the ground.

2.6 Regulations

The regulations require the designer of a CNRA “prototype” aeroplane to submit a calculation file to the DSAC, which checks it against standard CS-23. The structure of the wing is examined by an OSAC[10] inspector during the construction, before the skin is installed.

[9] Low-wing, single-engine piston aeroplane.

[10] The French civil aviation safety organisation carries out supervisory tasks on behalf of the DGAC.

For microlights, which are subject to the declaration system, the authority is not required to check the wing structure. As a result, the authority did not perform any examination of the AS-06 wing structure.

For non-serially produced microlights (such as the AS-06), the manufacturer must compile and make available a technical file (flight tests, structural tests, noise tests, manuals) upon request from the DSAC. The DSAC did not request the technical file for the AS-06.

3 CONCLUSIONS

The conclusions are solely based on the information which came to the knowledge of the BEA during the investigation.

Scenario

The pilot performed a local flight including steep turns and two low passes at high speed over the runway. At the end of the second low pass, during a smooth pull-up manoeuvre coupled with a left turn at a bank angle of approximately 20°, the left wing failed. The uncontrollable microlight suddenly lost height and then collided with the ground in a field beyond the end of the runway.

Contributing factors

The following factors very likely contributed to the failure of the left wing:

- brazing defects on the left spar, which caused the fatigue failure of at least one of the wings;
- the repeated performance of manoeuvres which put stress on the spar (steep bank turns, low passes at high speed followed by a pull-up manoeuvre coupled with a turn), in a context where no calculations had validated the design of the microlight's primary structures.

Safety lessons

Sharing best practices:

This accident underlines the advantages of working with a federation when making amateur-designed-and-built microlights. By being a member of a federation such as the RSA or the FFPLUM[11], microlight amateur designers and manufacturers can benefit from support in their projects, thereby enhancing safety.

Unusual context of use:

The absence of calculations to validate the design of the microlight's primary structures, combined with the repeated performance in flight of non-standard manoeuvres that put stress on its structure, led to a situation where the microlight failed during one such manoeuvre.

By way of comparison, aeroplanes used in aerobatic flying are developed in a context where their structural strength is clearly defined, and their primary structures are designed to withstand repeated stresses.

[11] French Microlight Federation.