Accident to the G1 Aviation G1 SPYL-XL-R ULS (P) identified 04IF on Saturday 4 February 2023 at Salignac (Alpes-de-Haute-Provence)

Time	Around 11:20[1]
Operator	Pôle National de Vol Montagne (PNVM)
Type of flight	Instruction flight
Persons on board	Pilot under instruction and instructor
Consequences and damage	Aircraft destroyed, occupants unharmed
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.	

Distortion of both wings in flight in rough air, loss of control, activation of the airframe parachute, in instruction

1 HISTORY OF THE FLIGHT

Note: the following information is principally based on the KANARDIA computers and the Air Avionics' Air Traffic AT-1 collision avoidance computer, the camera attached to the microlight[2] and statements.

The pilot under instruction took off at around 11:00 from Barcelonnette Saint-Pons airport (Alpes-de-Haute-Provence) (see **Figure 1**, point 1) bound for Cruis Mas de Grailles microlight strip (Alpes-de-Haute-Provence), to perform a flight with an instructor as part of the PNVM[3]. An intermediate touch-and-go was planned at Entrepierres private microlight strip (Alpes-de-Haute-Provence). On the route, the pilot climbed to approximately 7,500 ft and started the descent 10 min after take-off (Point 2). After passing the Baume mountain (Point 3), while the microlight was at an altitude of approximately 4,300 ft to the east of Entrepierres strip and descending, the instructor observed from a distance the strip's windsock which indicated turbulence. He decided to cancel the touch-and-go on this strip and to continue the flight to Cruis microlight strip.

A few seconds later, while the microlight was at an altitude of approximately 4,200 ft, on the downwind side of the mountain, the two pilots heard a noise. Part of the canopy tore off, then the microlight suddenly adopted a right bank angle and entered a spin. The instructor took over the controls and tried to regain control. After three full spins, as he was unable to regain control of the microlight, he released the airframe parachute at a height of approximately 1,200 ft (Point 4).

[1] Except where otherwise indicated, the times in this report are in local time.
[2] The glossary of abbreviations and acronyms frequently used by the BEA can be found on its web site.
[3] *Pôle National de Vol Montagne* (French School of Mountain Flying).

After the latter deployed, the microlight descended to the ground, pushed by the wind, and ended its descent in a field, hitting an olive tree. The two occupants evacuated the microlight and alerted the emergency services.

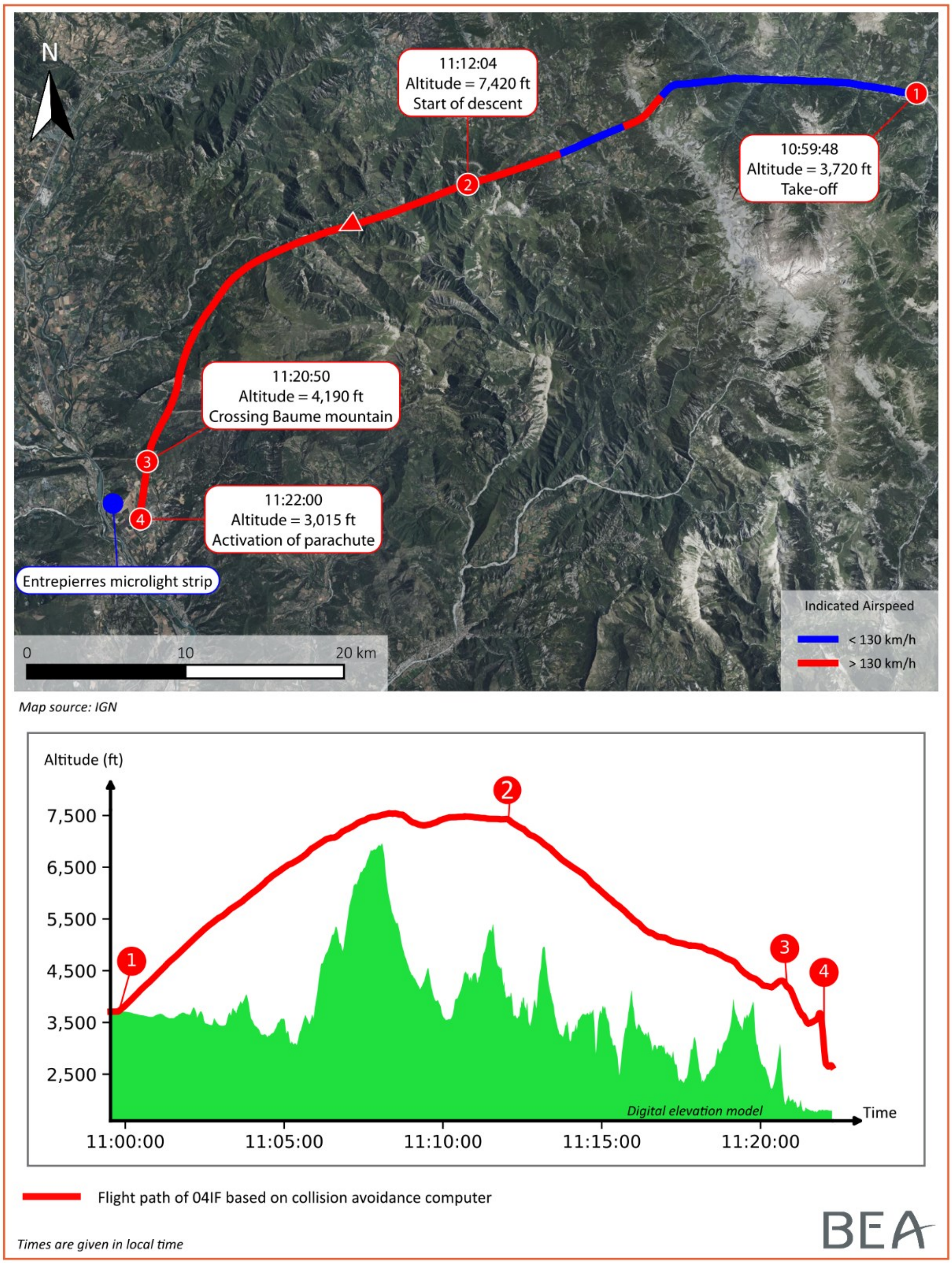

Figure 1: flight path

2 ADDITIONAL INFORMATION

2.1 Site and wreckage

N.B.: the BEA did not go to the accident site. The following information is based on the photos taken by the pilots and those first on the scene.

The accident site was located in a field of olive trees at an altitude of 1,750 ft (see **Figure 2**).

Figure 2: position of the microlight after the accident (Source: pilot in the left seat)

The main damage identified was:

- an upward bend in the centre of the right wing between the aileron and the flap, extending from the leading edge to the trailing edge;
- a depression of the leading edge in the centre of the left wing;
- distortions on the left-wing upper skin between the aileron and the flap and at the junction with the fuselage;
- distortions on both sides of the fuselage, aft of the cockpit;
- a break in the windshield with its right-hand side missing.

2.2 Examination of video recordings from the onboard camera

A camera attached under the left wing was filming the lower surface as well as the left front part of the fuselage. The left-wing lower surface was visible and the right wing was not visible. The images recorded were retrieved by the BEA[4]. The flaps were retracted throughout the recording sequence.

[4] The video's sound recording was saturated with aerodynamic noise, and spectral analysis was unable to enrich the video analysis with major elements coming from the power unit.

Frame-by-frame analysis of the video[5] and spectral analysis showed the following, in chronological order:

- the absence of significant turbulence from take-off to the moment of the sudden entry into a roll to the right. However, lenticular clouds[6] were observed;
- an increase in the spurious noise of the video, which may correspond to an aerological disturbance on passing the Baume mountain;
- a sudden change in the propeller speed;
- less than 1 s later, an entry into a roll up to approximately 30° (within 1 s) and a yaw movement to the right up to 15°. At the same time, a noise was heard. It was not possible to determine whether this noise was caused by mechanical or aerodynamic sources;
- a deflection of the wheel to the left, probably fully, and the wings going flat again;
- a slight upward distortion of the left wing when the wings went flat again;
- the readoption of a zero bank angle by the microlight for approximately 4 s;
- the adoption of another steeper right bank angle by the microlight, followed by a right-hand spin;
- three full right-hand spins, during which the microlight overturned;
- after the spins, the right door half-opened;
- the release and deployment of the airframe parachute, approximately 9 s after the microlight entered a spin;
- during the descent under the parachute, and before contact with the olive tree, the already effective upward bending of the right wing, based on the microlight's shadow on the ground[7];
- the depression of the leading edge in the left wing and the distortion of the fuselage when the microlight collided with the olive tree and the ground.

2.3 Wing examinations

2.3.1 Wing structure

Each wing is principally made of (see **Figure 3**):

- two front and rear spar assemblies consisting of one half-spar on the wing root side and a second half-spar on the wing tip side, which are joined together with a connector;
- thirteen ribs at the front, located between the leading edge and the front spar and numbered from 1 to 13 by the manufacturer;
- eleven ribs at the rear, located between the two spars[8] and numbered from 1 to 11 by the manufacturer.

[5] The frame sampling rate was 29 frames per second.

[6] Lenticular clouds are a sign of strong winds and strong turbulence with downdraughts downwind of the terrain, or even severe turbulence below the lowest rotors.

[7] However, it was not possible to determine exactly when the wing bent.

[8] There are no rear ribs No 3 and 4. The fuel tank is installed in this area.

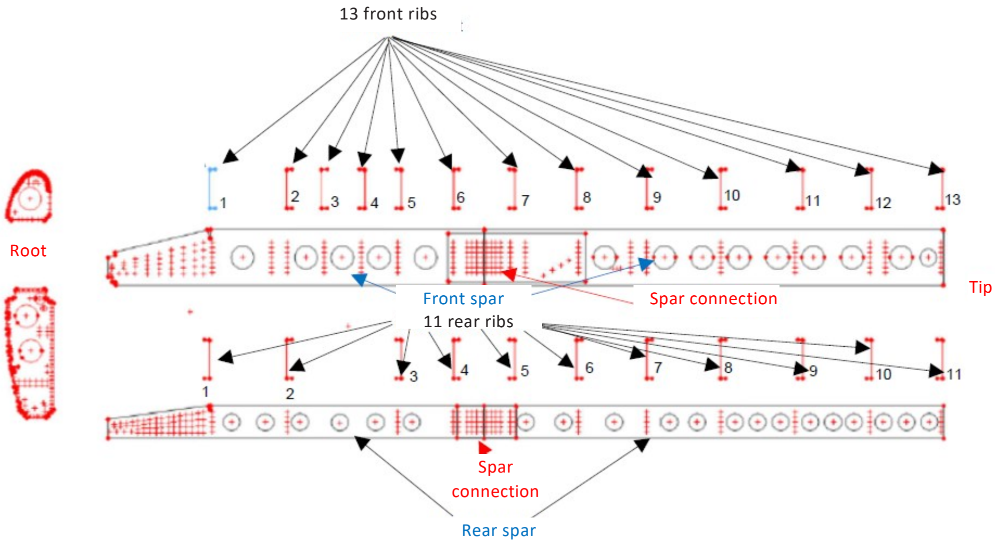

Figure 3: wing structure (Source: G1 Aviation and BEA annotations)

The wing spars and ribs are made from 0.5 mm to 1 mm thick aluminium-plated sheets with lightening holes[9]. This metal structure is covered with riveted aluminium sheets.

The wing also consists of two false spars installed in front of the rear spar between ribs No 5 and 6, and then between ribs No 6 and 7.

Brackets are also installed in line with frame No 6 to stiffen the front and rear brace arms, one on the front spar and the other on the false spar.

2.3.2 Examination results

Visual examination of the fuselage:
Observations showed that the damage to the fuselage was most likely the result of the collision with the olive tree and the ground.

Visual examination of the braces:
No damage or distortion was observed at the upper fasteners of the braces. In the absence of any substantial damage, no further examination was performed on the braces.

Visual examination of the right wing:
The rivets of the right-wing upper skin were removed between rear ribs No 5 and 8 (front ribs No 7 and 10). Visual examination of the right-wing upper skin showed wave like distortion between rear ribs No 6 and 7 (front ribs No 8 and 9).

Visual examination of the right-wing internal structure revealed the following (see **Figure 4**):

- local fracture of the upper part of the front spar under compressive/bending stresses;
- no distortion in line with the stiffeners of the brace upper fasteners;
- fractured rivets at the angle fastening the aileron bellcrank mounting bracket, in a front-to-rear movement;
- fracture of the right false spar under compressive/bending stresses;

[9] Lightening holes made in wooden or metallic components of an aircraft to reduce its weight.

- distortion of the rear spar under compressive/bending stresses, along with local tears in the spar web. All of this damage, substantial in line with the lightening holes in the spars (front, rear and false spars), did not restrict the movements of the aileron control rods and the aileron;
- distortion of rear ribs No 6 and 7 (front ribs No 8 and 9). This distortion was the result of the forces undergone by the spars under compression/bending (see **Figure 4**).

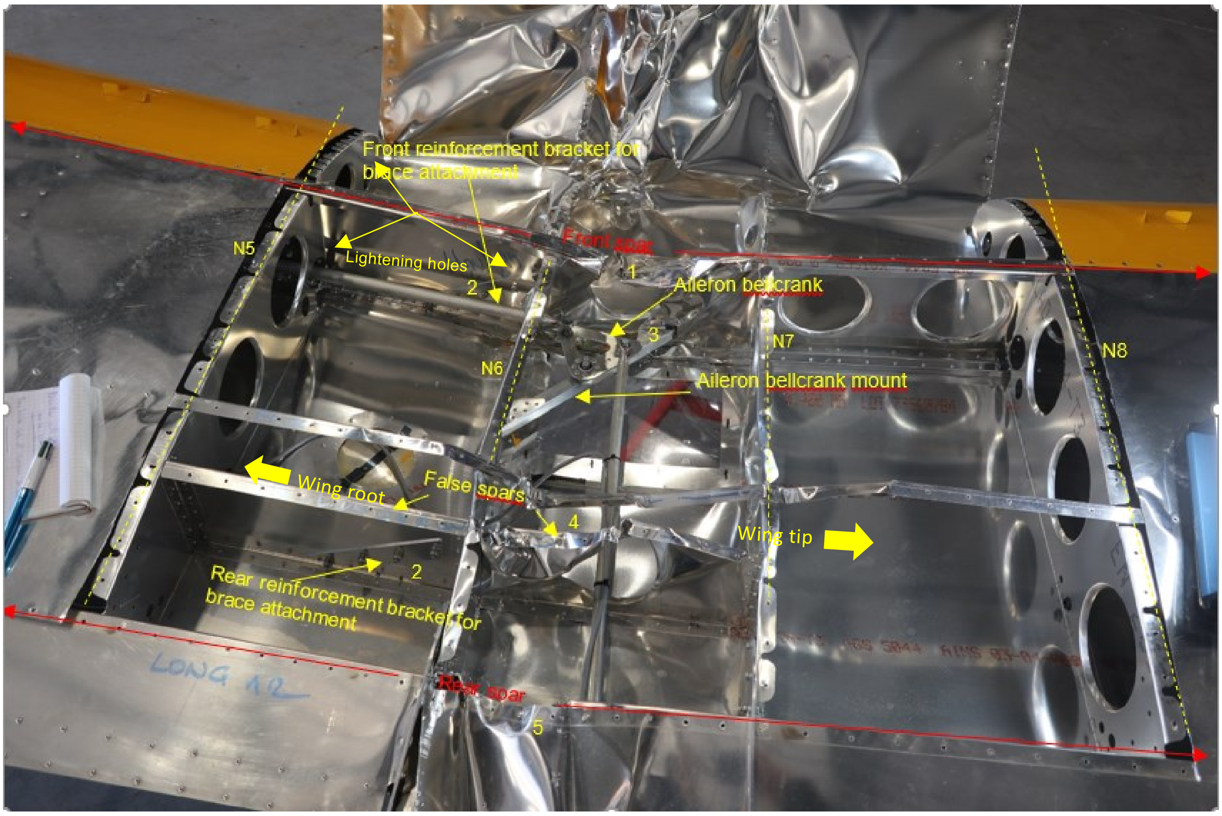

Figure 4: general view of right wing damage between rear ribs No 6 and 7 (front ribs No 8 and 9) (Source: BEA)

Visual examination of the left wing:

During the visual examination at the BEA, the rivets of part of the left-wing upper skin were removed. Visual examination of the left-wing internal structure showed damage similar to that observed on the right wing, but less pronounced (see **Figure 5**). No further examination was performed on this wing.

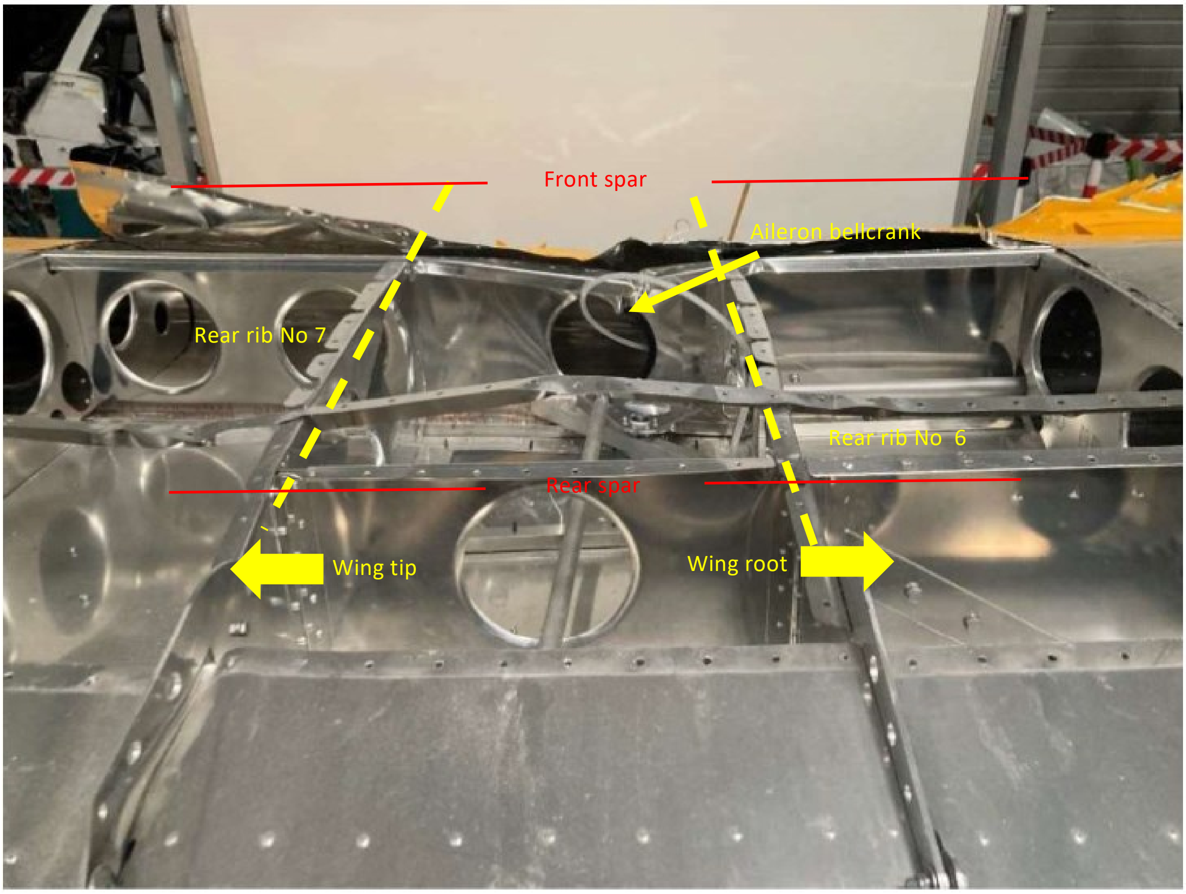

Figure 5: left wing folding (Source: BEA)

Further examinations of the right wing:

Part of the fracture face of the front spar was observed using a Scanning Electron Microscope (SEM) at the BEA's laboratory. This examination showed that the failure was of a sudden nature due to overload, and no prior damage (corrosion, fatigue) was observed.

An optical microscopy check of some parts of the wing showed that the metallurgical characteristics of the material (microstructure, plating) corresponded to those declared in the G1 AVIATION reference technical record.

2.4 Examination of the onboard computers

Two computers developed by Kanardia (Indu altimeter and Digi Engine Information System) and an Air Traffic AT-1 collision avoidance system developed by Air Avionics[10] were examined at the BEA.

Analysis of the data recorded in relation to the event flight showed that between 11:07:44 and 11:08:44 as well as between 11:10:10 and 11:21:46, the indicated airspeed always exceeded 130 km/h. During the 45 s preceding the first entry into a roll to the right, it oscillated several times between 140 km/h and 170 km/h, while the ground speed varied between 205 and 230 km/h. When the aircraft entered a roll, the indicated airspeed was around 170 km/h, while the altitude was approximately 3,600 ft. Two seconds later, the indicated airspeed increased to around 185 km/h, and the altitude to approximately 3,725 ft. The aircraft entered a right-hand spin at 11:21:51, after which the engine speed decreased from 4,680

[10] Collision avoidance computer combining Flarm, ADS-B and Mode-S data.

to 1,540 RPM. The parachute actually deployed at 11:22. The altimeter recording stopped at 11:22:11 and the Flarm recording stopped at 11:22:15.
Comparative flights with a G1 SPYL XL-R ULS(P) microlight and a G1 SPYL-XL C100 (P) were conducted to make sure that the data recorded by the Kanardia computers was usable as part of the investigation. These flights showed overall consistency. In particular, it appeared that the indicated airspeed recorded by the Kanardia computers during the accident flight could therefore be considered as representative of the airspeed displayed on the 04IF airspeed indicator.

2.5 Microlight information

2.5.1 Limitations and performance

The microlight's user manual indicates that the airspeed never to be exceeded (Vne) is 200 km/h. The maximum speed in rough air (Vno[11]) is not indicated. The maximum gust speed (Ve) and the manoeuvring speed (Va)[12], both equal to 130 km/h, are indicated and not explained.

Note: The initial version of the French Directive dated 23 September 1998 pertaining to motorised microlights indicated that the maximum gust speed could be equal to the manoeuvring speed (Va) for a simple microlight and corresponded to the maximum speed in rough air. However, the subsequent versions of 21 February 2012 and 24 June 2019 specified that, for a simple microlight, the maximum gust speed could be equal to the maximum speed in rough air Va. Consulted during the investigation, the DSAC specified that there had been an error when reusing the text of the initial version of 1998 and confirmed that on this type of simple microlight, the maximum gust speed can indeed be equal to the manoeuvring speed Va and corresponds to the maximum speed in rough air Vno. The definition of the Vno is not present in any version of the Directive pertaining to microlights.

The microlight was equipped with an airspeed indicator marked with a green arc between 65 and 130 km/h, a yellow arc between 130 and 200 km/h, and a red line at 200 km/h. There was no indication on the airspeed indicator identifying the Vne, Vno, Va and Ve values.

At the time of the accident, the microlight's weight was close to its maximum take-off weight with parachute (525 kg) and the balance was within the limits defined by the manufacturer. The user manual indicates a limit load factor of +4 g and -2 g for the microlight, at the maximum weight of 525 kg.

2.5.2 Demonstration of the limit load

According to the initial technical record drawn up by G1 AVIATION for the issuance of the first identification sheet at the maximum weight of 450 kg, the wing loading tests conducted in 2005 demonstrated a limit load factor of +4 g.

As part of the investigation, the BEA studied the calculation file drawn up in August 2019 to increase the maximum weight to 525 kg (file complying with paragraph 7.5 of the French Directive of 24 June 2019 pertaining to motorised microlights). In particular, the BEA identified the following points:

- the safety factors were only checked against the materials' tensile strength data, whereas some parts involve compressive forces;

[11] A sudden manoeuvre or gust at a speed greater than the Vno in turbulent air may cause permanent distortions of the airframe.
[12] The French Directive dated 24 June 2019 pertaining to microlights defines the Va as the speed of sudden and full deflection of the control surfaces.

- the stress concentration factors associated with the wing's lightening holes were not taken into account, or their consideration is not indicated;
- the materials' data used in the calculation file and the material certificates provided as part of the investigation were inconsistent (absence of sheet plating, acceptance criteria lower than the data used in the calculation file)[13].

In addition, the technical record check conducted by the DSAC during the investigation revealed the absence of any document attesting to the performance of ground tests at 525 kg. The DSAC approached G1 AVIATION to ask the company to conduct a static test in line with the specifications on the identification sheet, with a view to testing the microlight's structural integrity at 525 kg. In June 2025, G1 AVIATION, in coordination with the DSAC, conducted a static test on a wing having a single spar with a sheet thickness of 0.8 mm. According to the information provided to the BEA by the DSAC, this test led to a failure before the limit of 6 g required by the French regulations pertaining to microlights. The spar was found to have buckled between ribs No 6 and 7, slightly beyond the area of the brace moving towards the wing tip. The wing also showed substantial residual buckling on its upper surface around 0.7 m from the brace anchor area, towards the wing end.

2.5.3 Information about the use of the airframe parachute

The microlight's user manual describes the principles for activating the system and indicates in particular that, in the event of a critical situation, or accident, at any height, the parachute must be released immediately. It specifies that it is important to switch off the engine and ignition before pulling the release handle to prevent the extraction cable and the parachute from wrapping around the propeller hub, and then to close the fuel valve immediately if there is enough time. The user manual lists a number of situations in which the parachute must be used, including loss of control and spinning at low height.

2.6 Pilots' experience and ratings

2.6.1 Pilot under instruction information

The 51-year-old pilot under instruction held a fixed-wing microlight pilot certificate issued in August 2021. He had logged 128 flight hours in microlights, around 8 hours of which in the previous three months, and 26 hours on type, 1 hour and 15 minutes of which in the previous three months. Almost all the microlights he had flown were equipped with an airframe parachute. He was following the practical training as part of the course entitled "*Vol en région montagne*"[14] (Flying in a mountainous region) proposed by the PNVM.

2.6.2 Instructor information

The 68-year-old instructor, a retired airline transport pilot, held a Private Pilot Licence – Aeroplanes (PPL(A)) and a fixed-wing microlight pilot certificate issued in September 2010. He had also been a microlight instructor since 2014. In the past, during his training to become an airline transport pilot at ENAC, he had logged around 40 aerobatic flight hours. He held the microlight instructor "mountain flying" federal rating[15] issued on 15 July 2020.

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[13] In this case, the sheets examined on the 04IF microlight were indeed plated.

[14] Training and advanced courses in mountain flying.

[15] Federal rating (FFPLUM/AFPM) intended for instructors, awarded by the PNVM after completion of a specific course defining an educational framework. To date, 28 rated instructors are training microlight pilots for the "wheel" and "ski" mountain flight rating in the Alps and the Pyrenees.

He had logged around 440 instruction flight hours on microlights, and for the past two or three years, he had been providing training courses in the Southern Alps from Barcelonnette airport as part of the PNVM. He stated that he had logged 1,397 flight hours in microlights, 380 hours of which on type and 25 hours of which in the previous three months (21 hours of which on type).

2.7 Meteorological information

The instructor stated that he consulted the Windy application before take-off. The investigation was unable to determine the meteorological information he obtained before the flight.

The weather conditions estimated by Météo-France in the region and at the time of the accident were as follows: north-westerly to north-north-easterly wind from 15 to 35 kt between 2,000 and 5,000 ft, picking up to the south of Sisteron. The average ground wind recorded by the Saint-Auban weather station was a 010° wind of 22 kt, gusting up to 45 kt, while at Sisteron there was a 350°wind of 8 kt, gusting up to 17 kt. According to Météo-France, this was due to the presence of the cluse[16] of Sisteron, which causes the wind to accelerate due to the Venturi effect to the south of the Sisteron weather station. The wind at Salignac was therefore stronger than at Sisteron and probably close to that at Saint-Auban. Visibility was greater than 8 km and there were no low clouds.

The weather forecasts available before the flight (in particular, the SIGWX and WINTEM France charts valid from 09:00 UTC) were similar to those estimated after the accident by Météo-France.

The strong Mistral wind conditions are known to be conducive to turbulence and rotor phenomena in the region of Sisteron. According to the PNVM manager, a fairly strong Mistral wind was blowing that day, and it is known that there are often rotors in the area where the accident occurred. According to the chief pilot at the Centre National de Vol à Voile de Saint Auban, there was no gliding activity at the Château-Arnoux aerodrome that day.

2.8 Statements

2.8.1 Pilot under instruction's statement

He remembered seeing very high lenticular clouds in the distance during the flight. He stated that he encountered turbulence several minutes before the loss of control, and that he then talked with the instructor about aerology and the roll cloud and rotor phenomena. They were ready to turn around if the turbulence became too strong. He explained that just before crossing the Baume mountain, he asked the instructor if the wind flowing along the terrain would generate turbulence. The latter replied that he was not worried, as they were high enough and far enough away not to experience its effects. Just before the loss of control, he felt slight vibrations and then symmetric impact. He thought that he reduced the power, and when the microlight suddenly adopted a bank angle, he put the stick to the left to counter the entry into a roll to the right and remembered a feeling of "sluggish controls". He did not remember what the speed was when the aircraft entered the roll. He then handed over the controls to the instructor and was about to pull the parachute handle when the instructor pulled it. The instructor then asked him to switch off the engine. He cut off the magnetos and the power contact and did not think about shutting off the fuel supply.

[16] Narrow gorge-like passage carved perpendicular to a mountainous area, leading downstream.

He explained that in the past, he had received information from his instructors on how to use the parachute. He indicated that he had not read the part of the user manual relating to the airframe parachute and that he had searched for information on the Internet. He had already seen once or twice, on the ground, the manoeuvres to carry out and the instructor had explained to him, in flight, the different situations that could lead to the decision to use the airframe parachute.

2.8.2 Instructor's statement

He explained that he expected to find the same aerological conditions at Cruis as at the Entrepierres microlight strip. According to him, they were flying at around 140 km/h based on the airspeed indicator when he simultaneously heard a bang and saw the windshield break. He explained that he associated the noise with the break in the windshield and the rush of air into the cockpit. He said he was taking over the controls, but given that his helmet was partly torn off and the ambient noise caused by the wind rushing into the cockpit, he was not certain that the pilot under instruction heard him. The microlight then adopted a right bank angle and entered a first full spin. He reduced the throttle and put the stick in neutral as soon as the microlight started to pitch nose-down. He applied full left rudder twice to create induced roll and, as these inputs proved unsuccessful, he decided to release the parachute.

2.8.3 PNVM manager's statement

He was providing theoretical ground training that day. He indicated that the PNVM recommends its trainees not to fly in the Alps in strong Mistral winds because, in these conditions, there are rotors to the south of Sisteron, where the accident occurred. He specified that in the valley between Gap and Vinon-sur-Verdon, the wind direction and intensity can be highly variable.

He added that it is not recommended to land in the mountain in winds of more than 8 kt, to fly in mountainous areas in winds of more than 15 kt, and to take off in winds of more than 30 kt, as this involves major risks.

2.9 Information about PNVM training on flying in turbulent conditions

The theoretical training course delivered by the PNVM contains a module dedicated to aerology in which it is taught to move away from the high and low limits of the aircraft's flight envelope when flying in turbulent air. It includes a reminder that the speed zone to be avoided in turbulent air extends from Vno to Vne, and is represented by the yellow arc on airspeed indicators. It specifies that, in strong winds at altitude, conditions in the lower layers may be incompatible with the microlight's safety and integrity.

The training course also explains to trainees that dynamic turbulence resulting from obstacles can be extremely severe, and that it can increase when it is associated with thermal turbulence.

3 CONCLUSIONS

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

Scenario

Even though there were strong Mistral winds in the region, the pilot under instruction and the instructor were flying in an air mass with low turbulence since take-off from Barcelonnette Saint-Pons. The pilot had been holding an indicated airspeed above the manoeuvring speed Va for ten minutes when the air mass became rougher as they crossed the Baume mountain near the Cluse of Sisteron. The pilot and instructor continued the flight, giving themselves the option of turning around. Shortly afterwards, when the indicated airspeed was 40 km/h above the Va, the microlight suddenly entered a roll.

When the microlight banked to the right, the pilot under instruction, surprised, and to counteract this start of roll, instinctively made a sudden and large input, at least on the rudder control and most probably on the roll and pitch controls.

He lost control of the microlight, which entered a spin. The instructor took over the controls and tried to regain control of the microlight. Observing that his inputs on the controls had no effect, he quickly pulled the airframe parachute handle. This input caused the airframe parachute to open at a sufficient height, allowing the occupants to survive.

The investigation was unable to determine the exact sequence, in particular the precise moment when the wings distorted. The structural under-dimensioning of the wings brought to light during a static test conducted by G1 AVIATION as part of the safety investigation, the indicated airspeed substantially higher than the Va in rough air, as well as the sudden deflection of one or more control surfaces above this speed, were cumulative factors likely to have contributed to a structural degradation of the wings.

Measures taken by the DSAC and the manufacturer

Following the tests conducted in June 2025, pending the definition by G1 AVIATION of a stiffening solution for G1 microlights having a single spar with a sheet thickness of 0.8 mm and additional checks for other G1 microlights, the DSAC issued an airworthiness directive[17] imposing restriction of the flight envelope - in particular the restriction of the maximum speed in rough air to 110 km/h - as well as restrictions relating to commercial activities.

Safety lessons

Turbulence: anticipating the threat

The information sheet No 20 published on the FFPLUM web site about measuring the wind, "*Anémométrie Doc. (3/4)* ", defines the different characteristic speeds in microlights. This sheet specifies that the yellow arc on the airspeed indicator is a caution zone corresponding to the range of speeds that can be used in calm air only. Its limits correspond to the Vno and the Vne.

This range must not be used in turbulent air, failing which pilots expose themselves to the risk of exceeding the aircraft's structural integrity limits.

[17] Airworthiness directive available on the DGAC web site.

The investigation showed that, although the air became rougher at the very end of the flight, the pilot and instructor did not encounter severe turbulence until the moment when the aircraft entered a roll. However, the aerological conditions that were forecast and could be observed were conducive to encountering severe turbulence, in particular on approaching the terrain overflown at the time of the accident. Moreover, the presence of lenticular clouds indicated this threat. This risk can be anticipated by taking this type of information into account.

Activating the airframe parachute

The consequences of a collision with the ground resulting from a loss of control in flight are generally fatal. By activating the airframe parachute at a sufficient height, the instructor preserved the occupants' chances of survival.

As part of the accident investigated in this report, several key factors already identified by the BEA during other events[18] encouraged pilots to activate the parachute:

- assimilation of the parachute principle through personal research;
- familiarisation on the ground with the activation manoeuvres;
- defined and shared release criteria;
- an unambiguous situation with an incomplete aircraft.

The FFPLUM posted on its web site a flight safety bulletin entitled "*Sauvez vos vies avec le parachute de secours*" (save your lives with the airframe parachute).

The BEA investigations are conducted with the sole objective of improving aviation safety and are not intended to apportion blame or liabilities.

[18] See the accidents to 04FO and 67BVN and a forthcoming BEA study entitled Activation of airframe parachute: cognitive, emotional and physical mechanisms.