BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile
www.bea.aero
@BEA_Aero

INVESTIGATION REPORT

Accident to the AVEKO VL-3-A identified 59DAE

on 22 May 2020
at La Ferté-Bernard (Sarthe)

[1] Except where otherwise indicated, the times in this report are in local time.

Time	Around 08:25[1]
Operator	Private
Type of flight	Local
Persons on board	Pilot
Consequences and damage	Pilot fatally injured, microlight destroyed
This is a courtesy translation by the BEA of the Final Report on the Safety Investigation published in May 2021. As accurate as the translation may be, the original text in French is the work of reference.	

Increase in speed almost up to the VNE, in turn, mid-air rupture of the RH section of the horizontal tailplane and collision with the ground

1 - HISTORY OF THE FLIGHT

Note: the following information is principally based on statements and recordings from the Electronic Flight Instrument System (EFIS) installed on the instrument panel.

Alone on board, the pilot took off at 07:54 from his privately owned microlight strip located at Sceaux-sur-Huisne (Sarthe) and headed north. He flew over the houses of a female friend (blue path in Figure 1) and his pilot friends. He tried to contact one of them by telephone during the flight. The read-out of the parameters recorded in the EFIS showed that the height of the flight was around 1,500 ft and that the air speed was around 230 km/h during the flight.

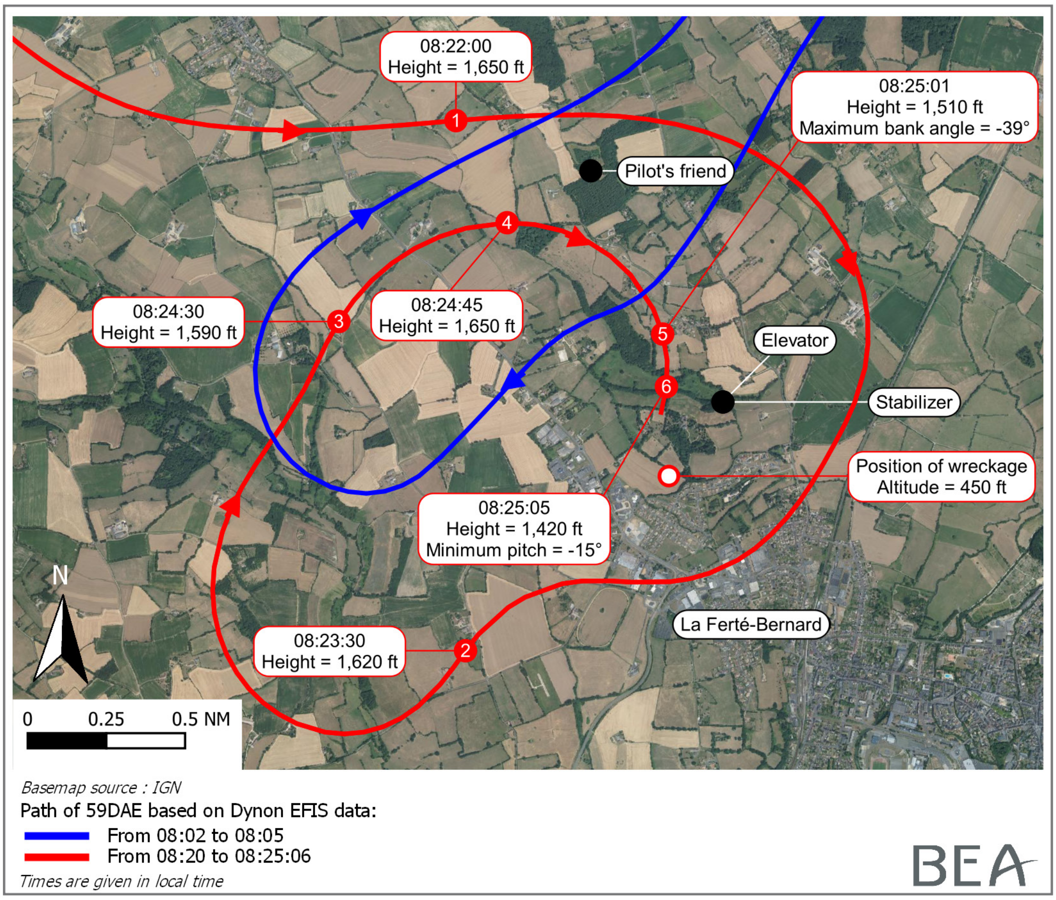
At 08:22, at a height of around 1,650 ft (point ❶ in Figure 1), after approximately 25 minutes of flight northwards of his strip, the pilot initiated a turn-around to the right around the house of a friend who, seeing him, waved at him from her garden. During this turn, the microlight had a bank angle of around 20°. The pilot then initiated a second turn-around to the right (point ❷ in Figure 1), with a bank angle of around 25°.

The pilot initiated a third turn-around to the right (point ❸ in Figure 1) with a bank angle of around 25°. At 08:24:45 (point ❹ in Figure 1), the microlight's bank angle increased gradually and the pitch started to decrease. The air speed was approximately 240 km/h and increasing. Sixteen seconds later (point ❺ in Figure 1), the bank angle reached a maximum of 39° and the microlight had a nose-down attitude of 11°. Four seconds later (point ❻ in Figure 1), the microlight had a minimum nose-down attitude of 15° and the bank angle was 25°.

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

One second later, at a height of 1,200 ft, with an air speed of 295 km/h, the bank and pitch parameters varied between the minimum and maximum values that could be recorded. The microlight collided with the ground several seconds later.

Witnesses on the ground reported to have seen the reserve parachute deploy from the microlight when the latter was level in height with the top of the trees.



Source: BEA

Figure 1: Partial path of 59DAE

2 - ADDITIONAL INFORMATION

2.1 Meteorological information

At the time of the accident, the meteorological conditions were CAVOK with an established southwesterly wind of 10 to 20 kt on the ground. At around 2,000 ft, there was an established southwesterly wind of around 25 kt.

2.2 Pilot information

The 55-year-old pilot held a class 3 (fixed wing) microlight pilot certificate issued in 1995. His logbook indicated a total of around 450 flight hours, 135 hours of which in the 59DAE.

The day before the day of the accident, he had flown for 15 minutes. Before this flight, he had not flown since September 2019 due to it being a particularly wet autumn and winter making his grass strip unusable and due to the period of lockdown in response to the COVID-19 pandemic.

2.3 Microlight information

2.3.1 Characteristics

The VL-3-A is a class 3 (fixed wing) microlight with a composite structure. The serial number of the 59DAE is 52. It was equipped with a ROTAX-912-ULSFR engine and a variable-pitch propeller, flaps and retracting landing gear. The pilot was the owner.

VL-3s with serial numbers below 100 were built by the Czech company Aveko. The Belgian company JMB Aircraft (former importer of VL-3s from Aveko under the name of JMB Aviation) took over manufacturing VL-3s in 2012 and made several modifications, in particular to the horizontal tailplane.

The main characteristic speeds of this microlight are:

- maximum speed with flaps extended (VFE) = 120 km/h;
- maximum cruise speed in turbulent air (VNO) = 225 km/h;
- cruise speed = 235 km/h;
- maximum speed (VNE) = 305 km/h.

In-flight tests carried out in a VL-3 with a serial number below 100 give a maximum proven speed in flight without flutter (VDF)(2) of 336 km/h.

(2) This speed is used to determine the VNE (VDF = VNE + 10 %).

The VL-3 is equipped with a reserve parachute. The parachute manufacturer states on its website that it takes around five seconds for the parachute to deploy. JMB Aircraft states that the parachute is operational up to the VNE and that in horizontal flight at 90 km/h, the height below which the parachute is not yet effective ("*Minimum projected rescue height*") is 80 m.

2.3.2 Engine intake system modification

During the winter and the period of lockdown, the pilot modified the engine intake system of his microlight to make it more fuel-efficient and to improve the performance of the microlight(3). This modification consisted in replacing the two original carburettors with an injection system manufactured by LAD aero. The day before the day of the accident, the pilot made an injection test flight (recorded in his logbook).

(3) The cruise speed can therefore be increased by around 10 km/h according to the manufacturer JMB Aircraft.

This modification of the engine intake system is classified as a minor modification and, as such, was not subject to a check by the maintenance workshop as this is not a regulatory requirement.

JMB Aircraft explained that this modification required a disconnection of the elevator trim control cables in the cockpit. At reassembly, any play(4) can cause an in-flight resonance phenomenon on the flight controls, at speeds below those indicated and written in the flight manual.

(4) The paragraph in the microlight maintenance manual pertaining to the tailplane assembly procedure, for the RH elevator, stipulates that the trim must be checked for unrestricted movement and turn direction. There can be no play.

2.3.3 Horizontal tailplane

The horizontal tailplane acts as a spoiler when flying in a straight line.

JMB Aircraft specifies that for VL-3s with a serial number below 100, the horizontal tailplane comprises two stabilizers (fins) equipped with movable elevators that are not balanced. The single elevator trim tab overlaps the trailing edge of the RH elevator. Each stabilizer comprises a spar located midway along the chord.

Since 2012, on all VL-3s with a serial number of 100 or higher, the stabilizer is one-piece, passing through the fuselage, equipped with two spars (front and rear). The flight controls are balanced by adding balance weights at the ends (lead-filled tips). The spar manufacturing process was modified.

According to the manufacturer, this structural modification increases the flight envelope with a view to future developments (higher cruise speed and VNE).

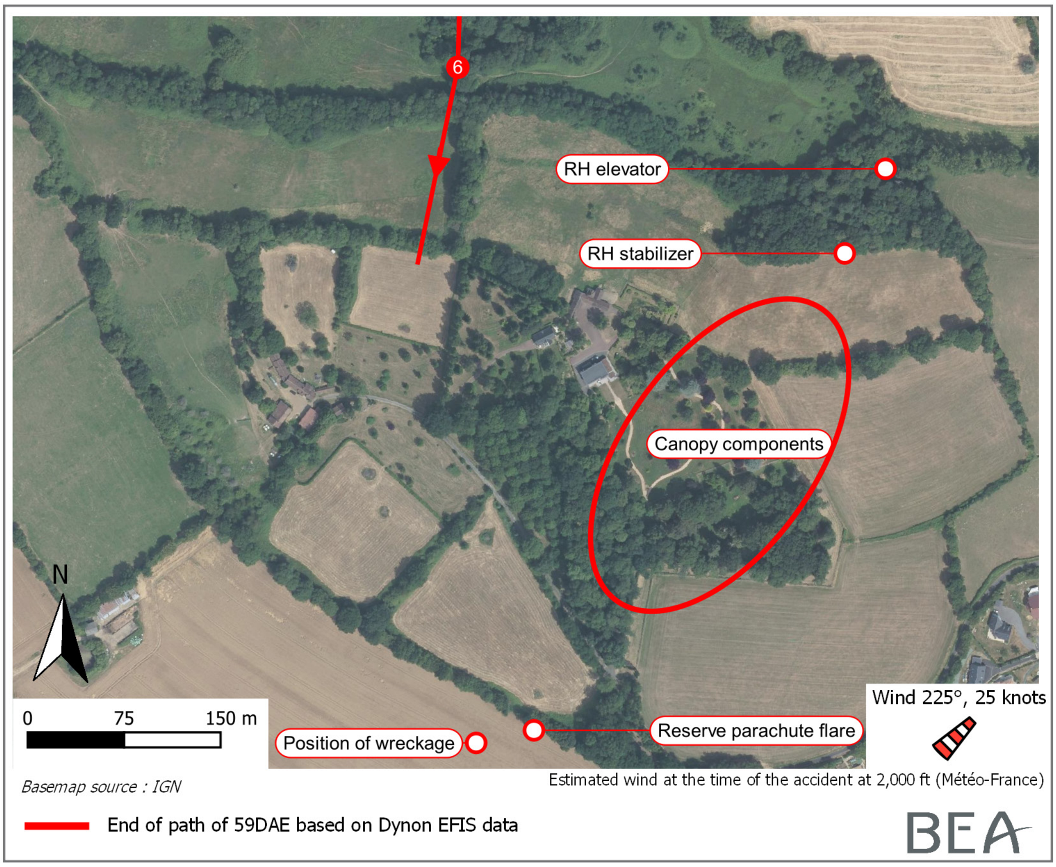
2.4 Accident site and wreckage information

2.4.1 Examination of the accident site and main wreckage

The accident site was located to the north-west of the town of La Ferté-Bernard in the vicinity of a residential district, 1.8 km south of the house of the pilot's friend.

Debris was spread approximately 400 m along the final path of the microlight before the position of the main wreckage. The following components were found in the forward-path order:

- the RH section of the horizontal tailplane (stabilizer and elevator separated);
- fragments of plexiglass from the canopy;
- the reserve parachute ejection flare;
- the main wreckage containing the LH section of the horizontal tailplane.



Source: BEA

Figure 2: Distribution of 59DAE debris

The distance between the main wreckage and the debris of the RH section of the horizontal tailplane (stabilizer and elevator) indicated that the latter became detached in flight from the rest of the airframe, whilst the microlight was still fairly high. This was the same for the canopy elements. The deviation between the position of the debris and the path can be explained by the drift due to wind during the flight.

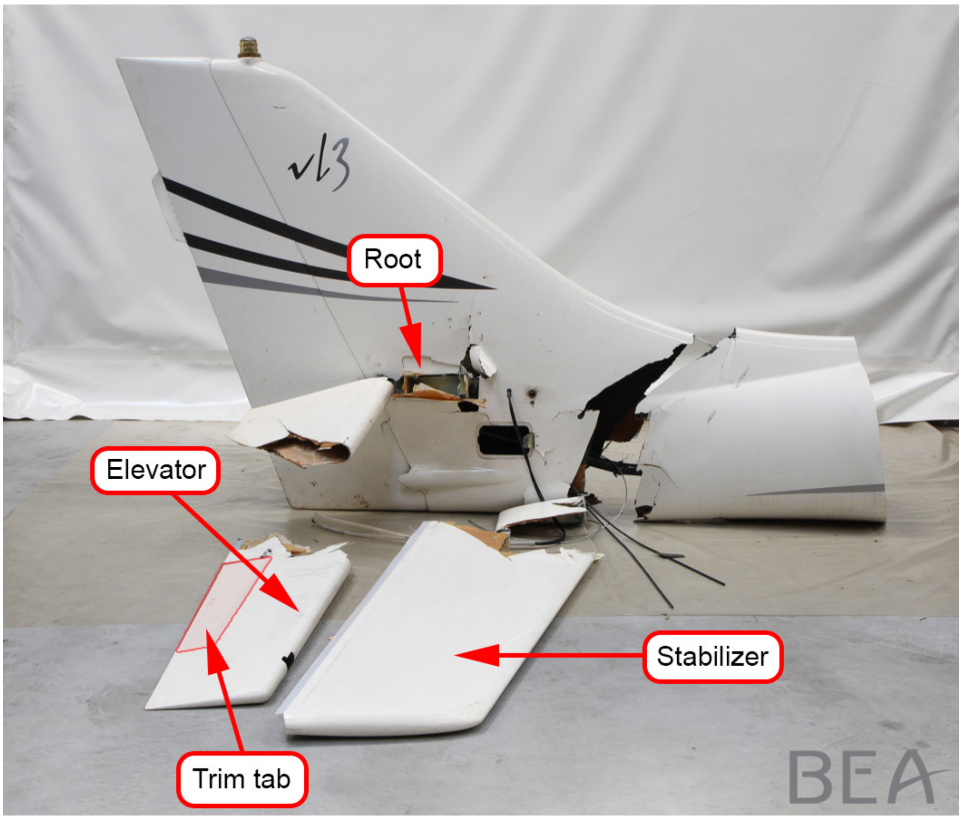
The short distance between the reserve parachute ejection flare and the main wreckage (approximately 50 m), combined with the fact that the deployment grip in the cabin was found out of its recess, indicate that the parachute was activated voluntarily by the pilot at a low height, shortly prior to the collision with the ground.

The microlight collided with the ground at high speed, with a nose-down attitude and a right bank angle.

The examination of the main wreckage was able to determine that the flight control linkages on all three of the microlight's axes were continuous when the microlight collided with the ground.

The engine was correctly supplied with fuel and was delivering power when the microlight collided with the ground.

2.4.2 Examination of the horizontal tailplane



Source: BEA

Figure 3: Reconstruction of tailplanes at BEA

The RH elevator and stabilizer became detached from the microlight in flight.

No signs of impact (bird, exterior element, parachute strap, etc.) were observed on these components.

2.4.2.1 Examination of the RH elevator

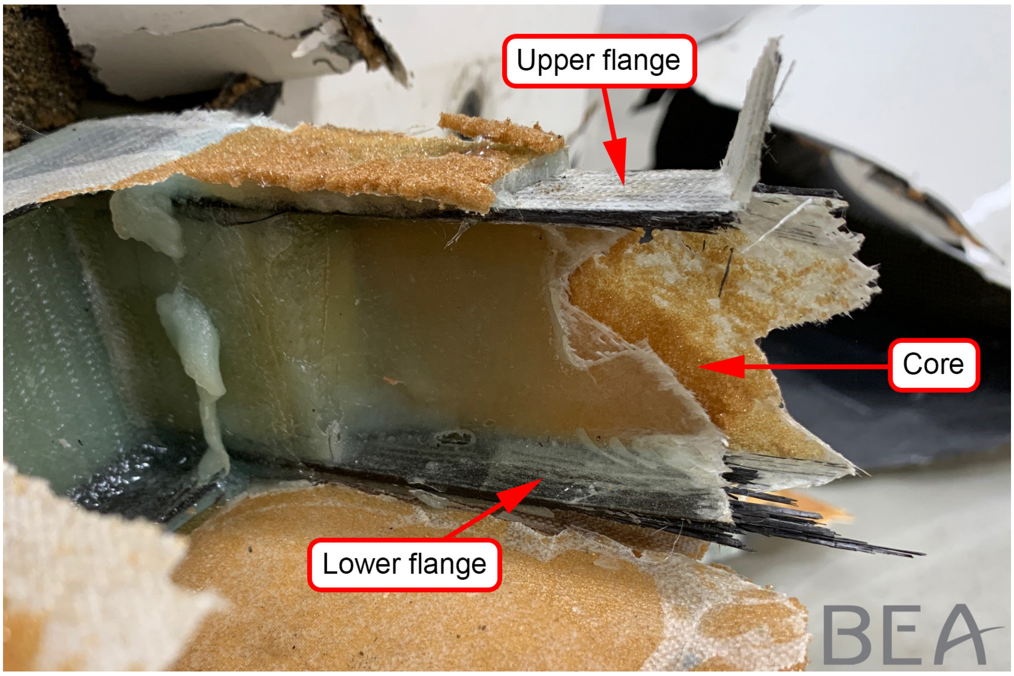
The RH elevator ruptured in the first third of its length from the root. Various damage showed evidence of both upward bending and downward bending overloads. This flapping can be explained by the occurrence of a flutter phenomenon on the elevator. The elevator stops did not appear to have been overshot. In addition, the elevator trim control cables were still integral with the elevator when it ruptured mid-air.

The rear spar of the stabilizer presented tears in line with the routing of these cables. The elevator then slipped sideways towards the exterior, relative to the stabilizer, the only movement enabled by the connecting hinges between the elevator and the stabilizer.

2.4.2.2 Examination of the RH stabilizer

The damage observed on the RH side of the tail fin, at the stabilizer root, indicated that the stabilizer ruptured under upward bending and torsional load towards a reduction in incidence.

The stabilizer spar comprises two carbon/epoxy composite flanges sandwiched between layers of glass fibre, and a core. This core comprises a high density glass fibre/foam sandwich (see Figure 4). The flanges are manufactured using carbon fibre unidirectional tape (interlinked strands) coated by hand with epoxy resin using a brush, before being cured in a vacuum bag.



Source: BEA

Figure 4: Broken spar of the RH stabilizer

[5] A layer stop consists in an interruption of a carbon layer (tape) in compliance with the manufacturing drawings with the aim of reducing the thickness of the flange the closer to the tip it becomes.

The examinations of the spar rupture zone revealed:

- a rupture of the stabilizer due to overload, around 10 centimetres from the root, in line with a layer stop[5] in the composite flanges;
- the lower flange broke under tensile load, the upper flange under compression (rupture of spar under upward bending load);
- the presence of dry zones (no resin) in the composite flanges;
- the presence of many inter- and intra-strand voids in the flanges, with a mean overall void ratio of around 8 %. These ratios are consistent with the manufacturing process used.

The examinations showed that the resin presented an acceptable cure rate.

In addition, the LH stabilizer spar was also examined and similar observations were made with regards to its composition.

Lastly, the front spar of the stabilizer of a VL-3 with a serial number above 100 was examined by way of comparison. The flanges of this spar had very little or even no void. These observations are consistent with the method used to manufacture these pultruded carbon flanges[6].

[6] Pultrusion is a continuous process for manufacture of longitudinally-reinforced profiles, consisting in pulling filamentary reinforcements impregnated with resin or thermoplastic polymer through a heated die. The high temperature cures the resin or fuses the polymer and gives its final shape to the profile section.

2.4.3 Examination of the canopy

A detailed examination of the canopy was performed. No sign of impact (bird or element outside or inside the plane) that could explain the mid-air rupture was observed. All of the signs (earth and plants) observed were caused by the impact of the debris with the ground.

Due to the location of the wreckage debris, it is likely that the canopy broke during the mid-air rupture of the RH section of the horizontal tailplane.

2.5 Statements

2.5.1 Friend of the pilot whose house was flown over

The friend of the pilot whose house is near the accident site stated that the pilot often flew over her house. The pilot asked her to wave at him as he could see her clearly from the plane. On the day of the accident, from her garden, she saw him fly by twice, several minutes apart (red path in Figure 1). She waved at him both times. After the second fly-by, she went back inside the house then heard a loud noise. She did not imagine that the microlight had crashed.

2.5.2 Ground witnesses

Several witnesses near the accident site explained that they had seen and heard the deployment of the reserve parachute, several moments before the collision with the ground, whilst the microlight was level with the top of the trees.

2.6 Back to Flying

The French Microlight Federation’s (FFPLUM) Back to Flying initiative promotes the voluntary meeting between pilots and instructors. Flights with an instructor enable both normal and unusual situations to be addressed in order to gain a better understanding of them and to ensure that automatic reflexes acquired during initial training are not lost. A theoretical and practical programme is recommended, and covers in particular stall or tight turns. This initiative is recommended all the more after a long period of inactivity.

On 13 May 2020, after the first lockdown due to the COVID-19 pandemic, the FFPLUM published a press release[7] stating that dual flights were possible within the context of Back to Flying in compliance with certain rules, in particular those relating to health.

[7] https://ffplum.fr/actualites/2020/communique-ffplum-mercredi-13-mai

3 - CONCLUSIONS

The conclusions are solely based on the information which came to the knowledge of the BEA during the investigation. They are not intended to apportion blame or liability.

Scenario

In the months leading up to the accident flight, the pilot modified his microlight's engine intake system. The day before the day of the accident, the pilot made an injection test flight lasting around 15 minutes after seven months without flying.

On the day of the accident, the pilot flew over several friends' houses. The flight took place at a height of around 1,500 ft. During a turn-around towards the microlight strip, when the microlight was above the house of a friend, its pitch was significantly reduced whilst its speed increased, reaching close to the VNE.

The possible presence of play introduced on the elevator trim control linkage during the modification of the engine intake system by the pilot may have generated a flutter phenomenon on the RH elevator, causing flapping. Alternating forces rapidly increased until it ruptured mid-air. Integral with the stabilizer by its hinges, the elevator introduced an abnormal upward bending and torsional force on the stabilizer leading to the sudden rupture of its spar then to its complete separation mid-air.

With only half a horizontal tailplane remaining and a defective elevator, it is likely that the pilot was unable to keep control of his microlight, which continued to descend. The pilot deployed the reserve parachute at insufficient height and the microlight collided with the ground.

Contributing factors

The following factors may have contributed to the increase in speed, in turn, close to the VNE:

- flying over the houses of his friends, which likely drew the pilot's attention to elements not necessary for flight;
- the return to flying by the pilot after seven months of no flying, without a refresher flight with an instructor, contrary to the recommendations of the FFPLUM (Back to Flying initiative).

The following may have contributed to the mid-air rupture of the RH section of the horizontal tailplane:

- the increase in speed close to the VNE;
- a flutter phenomenon on the RH elevator due to probable play on the elevator trim control linkage introduced when the pilot modified the engine intake system;
- the lack of balancing of the elevator (VL-3 with a serial number below 100).

It was not possible to rule out the possibility that the perfectible quality of the stabilizer spar could have contributed to its premature rupture.

Measures adopted by the manufacturer

On 8 February 2021, JMB Aircraft published a *Safety Alert* to reduce the VNE from 305 km/h to 260 km/h for VL-3s with a serial number between 1 and 99, therefore applicable to all VL-3s produced by Aveko. This document was shared with the FFPLUM and the DSAC. The FFPLUM then circulated a Safety Flash to its subscribers.

The Safety Alert was accompanied by an email for French and Belgian owners, explaining the main facts of the accident of 59DAE and reminding them that, in the event of loss of control, it is essential to deploy the reserve parachute as quickly as possible. JMB Aircraft also points out that it is essential to remove the pin from the parachute before take-off.