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Accident to the AEROS LTD - Skyranger identified **12DM** on 8 March 2022 at Aix-Les Milles aerodrome (Bouches-du-Rhône)

Time	Around 15:00[1]
Operator	Private
Type of flight	Test flight
Persons on board	Pilot and passenger
Consequences and damage	Pilot fatally injured, passenger severely injured, microlight 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.	

Loss of control in initial climb, collision with ground

1 HISTORY OF THE FLIGHT

Note: the following information is principally based on statements and radio communication recordings.

Since he purchased his microlight, the owner made a number of substantial modifications. He installed a more powerful engine than the previous one and changed the propeller, stick, landing gear, instrument panel and flight instruments. Following all these changes, he carried out engine ground tests.

On the day of the accident, he was in the process of checking the flight readiness of the modified microlight. He planned a test flight accompanied by a passenger. He called out his intention to perform two right-hand circuits at low height for runway 14 to the Aix-Les Milles tower controller. At his request, he was cleared to line up from holding point C. Shortly after take-off, during the initial climb, the microlight adopted a steep attitude, sharply banked to the left and then hit the ground with a steep nose-down attitude.

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

Figure 1: photograph of the wreckage after the intervention of the emergency services (Source: BEA)

2 ADDITIONAL INFORMATION

2.1 Pilot experience

The 73-year-old pilot held a valid microlight pilot licence, as well as valid fixed-wing, passenger-carrying and fixed-wing microlight instructor ratings. As the pilot's flight documentation could not be found, it was not possible to determine the exact number of flight hours he had logged as a pilot and instructor. According to the president of an association of which the pilot was the vice-president, he had logged more than 1,000 flight hours.

He also held a valid Private Pilot Licence - Aeroplanes (PPL(A)) and a valid Single-Engine Piston (SEP) land rating.

2.2 Passenger experience

The 63-year-old passenger held a valid microlight pilot licence, as well as valid paramotor, flex-wing, fixed-wing, passenger-carrying and microlight instructor ratings.

He also held an Airline Transport Pilot Licence - Aeroplanes (ATPL(A)), as well as Single-Engine Piston (SEP) land and Flight Instructor - Aeroplane (FI(A)) ratings. He had totalled more than 18,000 flight hours, including 5,500 hours as captain, and, in particular, 1,400 hours on light aeroplanes and 500 hours on fixed-wing microlights.

2.3 Meteorological information

The meteorological conditions estimated by Météo-France at the accident site were as follows: south to south-westerly wind of 9 to 18 kt, low to moderate turbulence at ground level, visibility greater than 10 km, broken clouds with a base at a height of around 3,000 ft, temperature 15 °C, dew point temperature 4 °C, QNH 1,020 hPa.

About 30 seconds before the accident, the Aix-Les Milles aerodrome controller reported a wind from 180° of 8 to 12 kt over the frequency.

A witness, who arrived at the scene very shortly after the accident, specified that he observed that the windsock, located a few dozen metres from the wreckage, indicated a wind of 10 to 15 kt that was more or less blowing from the south-west.

2.4 Examination information

The examination of the microlight wreckage revealed the following:

- The pyrotechnic cartridge of the emergency parachute was activated, but the parachute did not deploy. The safety pin was no longer in place on the red handle in the cockpit. The activation of the pyrotechnic cartridge was probably linked to the stresses borne by the structure when it collided with the ground.
- The wreckage was complete and not dispersed. All of the damage observed on the wings, fuselage and landing gear was caused by the collision with the ground. The destruction of the left wing and the distortion of the associated brace were consistent with an aircraft banked to the left when the wing made contact with the ground on impact. The destruction of the front part of the fuselage and the distortion of the nose landing gear confirmed that the aircraft had a nose-down attitude at the time of the impact with the ground.
- The roll, rudder, flap and elevator controls were continuous. The elevators and rudders were attached and could move. The elevator trim control was continuous from the control up to the flap at the trailing edge of the right-hand elevator. The flaps were in place and operational. The flap control consists of a control handle fitted with a locking pin that fits into the detent notches of a three-position rack. A distortion was observed in line with the intermediate detent position on the notched rack and could correspond to the position of the flap locking pin on impact, i.e. one flap detent position, which is the recommended position for take-off. Due to the damage, the position of the throttle and elevator trim controls could not be determined.

The examination did not reveal any marker on the elevator trim control. The elevator trim control in the cabin could be moved easily. There was no friction device making this control more difficult to use[2]. A bungee cord was used to make the trim tab easier to move. It was attached to the elevator upper surface and to the trim tab control bellcrank. The bungee cord retraction force is lower than that observed on another Skyranger equipped with a metal spring.

[2] The investigation was unable to assess the force required to move the elevator trim control before the accident.

Figure 2: trim tab, bungee cord and elevator upper surface
(Source: BEA)

2.5 Aircraft history information

Note: the following information is mainly based on statements, since the documents gathered during the investigation did not comprehensively track the work carried out on the microlight from when it was purchased by the pilot.

The Skyranger microlight is delivered as a standard prefabricated kit. 12DM was built by Aeros, a company based in Kiev, and received its identification code in 2002. It entered into service on 7 June 2005 and was initially operated by an association of microlight pilots in Aveyron. It was then purchased in 2014 by a private individual, and finally in 2017 by another private individual. During this last period, it was operated at Salon-Eyguières aerodrome.

The pilot purchased 12DM on 22 May 2021. He planned to undertake training to obtain the microlight instructor mountain rating. He decided to replace some equipment on his microlight with the aim of then performing mountain flying instruction flights. He made the changes himself.

On 20 January 2022, he replaced the 80 hp (60 kW) ROTAX engine with a 100 hp (73.5 kW) ROTAX 912-ULS2 engine[3], which was previously installed on another aircraft and was overhauled prior to its installation on 12DM. During the engine installation, the pilot replaced the two throttle levers on the pilot and passenger sides with one central control. The pilot requested the services of a mechanic to check the assembly and electrical connections, synchronise the carburettors and ensure that the engine was properly lubricated. On 25 January 2022, the pilot carried out engine ground tests. On 10 February 2022, he changed the instrument panel and aircraft instruments,

[3] The 100 hp ROTAX 912-ULS2 engine is four kilograms heavier than the previous engine.

including the airspeed indicator and the engine tachometer. The investigation was unable to determine whether the replacement instrumentation was calibrated and checked.
On 15 February 2022, he replaced the propeller with an E-PROPS Durandal 100-M 175 propeller. He installed a new emergency parachute. The empty weight was changed very slightly.

He declared the above-described changes to the French civil aviation safety directorate (DSAC) and obtained the microlight's identification card in his name on 23 February 2022.

He later replaced the central stick with a dual stick system. He purchased the dual-stick kit offered by the manufacturer, but encountered difficulties during installation. The stick interfered with the structural tubes between the two seats. He had to modify the dual-stick system by drilling new fixing holes.

Finally, he replaced the wheels with larger ones, which he felt were better suited to the sites encountered when landing in the mountains, and modified the plexiglass doors.

On 3 March 2022, he carried out conclusive ground run tests.

2.6 Statements

Given the trauma caused by the accident, the passenger in the right seat had no memory of the flight preparation and accident.

2.6.1 Former owner of the microlight

According to the former owner, at the time of sale, the microlight's behaviour was safe. He indicated that the elevator trim was well balanced and allowed the microlight to cruise without any effort on the stick. He added that, by keeping the elevator trim in the position it had during the previous landing, the microlight had a tendency to adopt a nose-down attitude at take-off.

At the time of sale, he carried out a first flight with the future owner, during which everything went smoothly. He then handed over the controls to the future owner for another flight. The buyer remained seated in the right seat. The former owner reported that on take-off, the microlight immediately began to climb without any level-off phase to accelerate. He added that he felt a lot of apprehension during this flight and that it seemed to him that the pilot's inputs on the controls were too abrupt.

2.6.2 Pilot waiting at holding point B

A pilot instructor was with a student in an aeroplane at holding point B when the microlight took off. He indicated that he watched it line up in front of him and pick up speed as it began to run for take-off. He observed nothing abnormal and took his eyes off the Skyranger. He reported that he heard a permanent transmission over the tower frequency and then looked to the left. He saw the microlight collide with the ground, with a roughly vertical attitude and a bank angle on the yaw axis.

2.6.3 Air traffic controllers in the control tower

Four controllers were in the controller tower at the time of the accident. The controller using the tower frequency was watching the microlight during take-off. He indicated that the initial climb seemed normal to him, with a gradient that was perhaps a little steep. He then had the impression that the microlight was no longer moving forward, that its ground speed was dropping and that it was adopting a nose-up attitude. The microlight was at a height of approximately 30 to 50 metres. He reported that it then adopted a steep left bank angle and that its nose tipped downwards. He remembered exclaiming several times that the microlight was stalling ("*il décroche*"). The other controllers indicated that they then observed the end of the microlight's path.

According to their statements, it appeared that the microlight was flying with a steep nose-up attitude and a left bank angle, then made a little more than a half-turn in descent with a very steep nose-down attitude until it collided with the ground. The left wing and nose of the microlight hit the ground first.

2.7 Aerodrome information

Aix-Les Milles aerodrome has a paved runway 14-32. Four taxiways (A, B, C and D) located between the thresholds on either side of the runway lead to it. The Take-Off Distance Available (TODA) and the Accelerate Stop Distance Available (ASDA) for runway 14 is 1,504 m. From stop position C, the take-off distance available on runway 14 is approximately 925 m. The location of the point of impact is represented by a cross on the aerodrome VAC chart (see Figure 3).

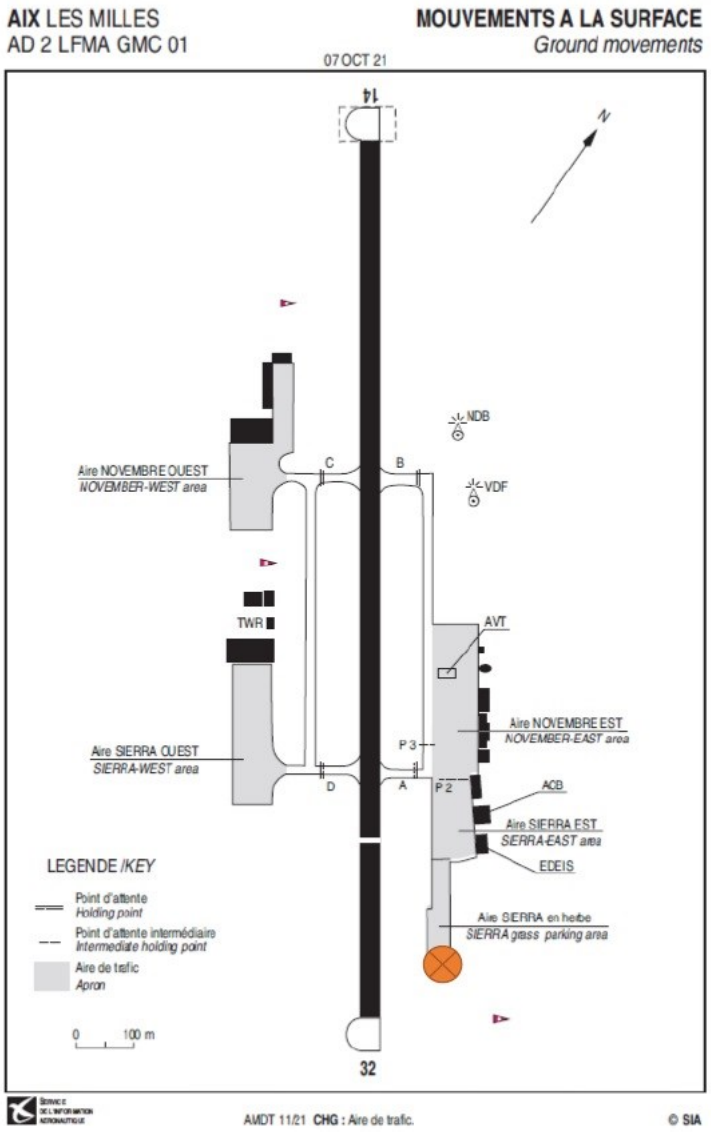

Figure 3: Aix-Les Milles aerodrome VAC chart (Source: AIS, BEA annotation)

2.8 Airworthiness regulations

The DSAC (the French civil aviation safety directorate) memo regarding changes made to a microlight ("*Modifications d'un ULM*") describes the regulations in force on the day of the accident[4].

The degree of substantiation required following a modification made to a microlight and the chosen substantiation method (calculation, ground or flight tests) are based on standard practices and are the responsibility of the owners. If the owners consider that they do not have the required skills, it is their responsibility to seek the support of qualified personnel to determine the consequences of a change. Chapter 7 of the instruction of 24 June 2019, entitled "*Conditions techniques applicables et programme de démonstration de conformité associé*" (applicable technical conditions and associated conformity demonstration programme) sets out the requirements

[4] Order of 23 September 1998 pertaining to motorised microlight aircraft (version in force on the day of the accident), clarified by the instruction of 24 June 2019.

applicable to the calculation file, ground tests and flight tests. This chapter is intended for all microlight owners, even if the changes made to the microlight are not major modifications within the meaning of the regulations.

Following a major modification, the microlight identification card is no longer valid. It becomes valid again when the owner sends the major modification declaration. Before sending the declaration, the latter must document the microlight's conformity with the applicable technical conditions in the technical file. If the owner considers it necessary to carry out flight tests for this demonstration, they must first send a provisional card application form, then carry out the flight tests and finally declare the major modifications.

Following a non-major modification, the owner must demonstrate that the microlight complies with the technical conditions of the instruction of 24 June 2019, either by calculation or during ground or flight tests. In particular, the microlight may not be used for any purpose other than flight testing until the owner has verified the modified microlight airworthiness and, in particular, its conformity to the applicable technical conditions. This process is the sole responsibility of the owner. The owner is not obliged to report any modifications to the DSAC.

For any major or non-major modification, flight tests may only be carried out with one person on board (owner or any other qualified pilot). To carry out this flight with two people on board, a waiver may be obtained from the DSAC, by substantiating the need for a second person on board with regard to the tests to be carried out and the contribution of this person to the safety of the flight.

In the case of 12DM, the modifications made to the flight controls and landing gear were not major within the meaning of the regulations, so the owner did not declare them. Nonetheless, in accordance with the regulations, he declared to the civil aviation authorities the major modifications associated with the new engine, the new propeller, the change in weight and the installation of a new emergency parachute. Moreover, he was obliged to keep an updated technical file of all major and non-major modifications showing that the modified microlight met the applicable technical requirements. This technical file could not be located by the investigation.

Before starting take-off, the pilot told the controller that he wanted to carry out a machine test flight. If it was a flight test, this type of flight could only be carried out with one person on board, as no waiver was requested from the DSAC.

3 CONCLUSIONS

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

Scenario

The pilot lost control of the microlight during the initial climb.

It is likely that the owner's objective was to assess the microlight's flightworthiness. Indeed, this was the first flight following major modifications likely to alter the microlight's flight behaviour. The pilot had announced to the controller that it was an aircraft test flight.

The technical file showing the microlight's compliance with the applicable technical conditions was not found. It was therefore not possible to clearly determine the extent of the changes made to the microlight.

The investigation did not bring to light any technical failure occurring during take-off that could explain the loss of control.

Contributing factors

The following factors may have contributed to the loss of control:

- a possible change in handling characteristics as a result of the modifications made to the microlight;
- a possible flight control behaviour change in roll and pitch;
- a position of the elevator trim that was potentially unsuitable for take-off, or a friction defect in the elevator trim control which could have made it move during take-off;
- a take-off with a crosswind component and light to moderate turbulence, not suitable for a flight test.

Safety lessons

When modifications are made to a microlight, even if the regulations do not require it, the recommendation is to call on the services of competent third parties. The microlight's owner may then make use of their knowledge of standard practices to calculate the potential impact of the modifications on the microlight's flight behaviour, assess the need for technical substantiation and choose the most appropriate substantiation method (calculation, ground or flight tests).

Flight tests may only be carried out with one pilot on board. The idea is to limit the number of people exposed to the risk of an accident. However, it may sometimes seem more pertinent to carry out specific flights with the help of a third party. In this case, a waiver may be granted by the DSAC.

Lastly, flight tests involve risks due to their specific nature. They should therefore be carried out with increased safety margins. In this accident, it would have been better to plan to use the entire runway take-off distance available, to avoid taking off with a crosswind component and to plan to climb to a height high enough to allow the emergency parachute to deploy in the event of an emergency, rather than carrying out a low-height runway circuit as announced by the pilot before take-off.