BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

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SAFETY INVESTIGATION REPORT

Accident to the Aéroservices Guépy 582 identified 25AAG on Tuesday 28 May 2024 at Thise

Time	Around 16:15[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. As accurate as the translation may be, the original text in French is the work of reference.	

Reduction in engine power in initial climb, loss of control in turn, collision with ground

1 HISTORY OF THE FLIGHT

Note: the following information is principally based on statements[2].

The pilot took off from runway 24R of Besançon - Thise aerodrome at around 16:10. Several eyewitnesses on the ground saw the microlight deviate to the left in initial climb and then return to and fly along the runway axis. They indicated that they heard variations in the engine speed. According to them, the microlight was flying at a height of no more than 50 m.

The pilot then turned right, in a northerly direction. The eyewitnesses once again heard variations in the engine speed. They would indicate that they thought the microlight was flying slowly. The microlight flew over a field bordered by a row of trees. According to the eyewitnesses, the microlight had a steep nose-up attitude and was flying at a low height. They then saw the pilot start a right-hand turn, the microlight tip onto its right-hand side and then plunge until it collided with the ground.

[1] The times given in this report are in local time.

[2] A portable GNSS computer (Garmin GPSMAP196) was found in the wreckage. The recording stopped before the accident, at the end of the roll.

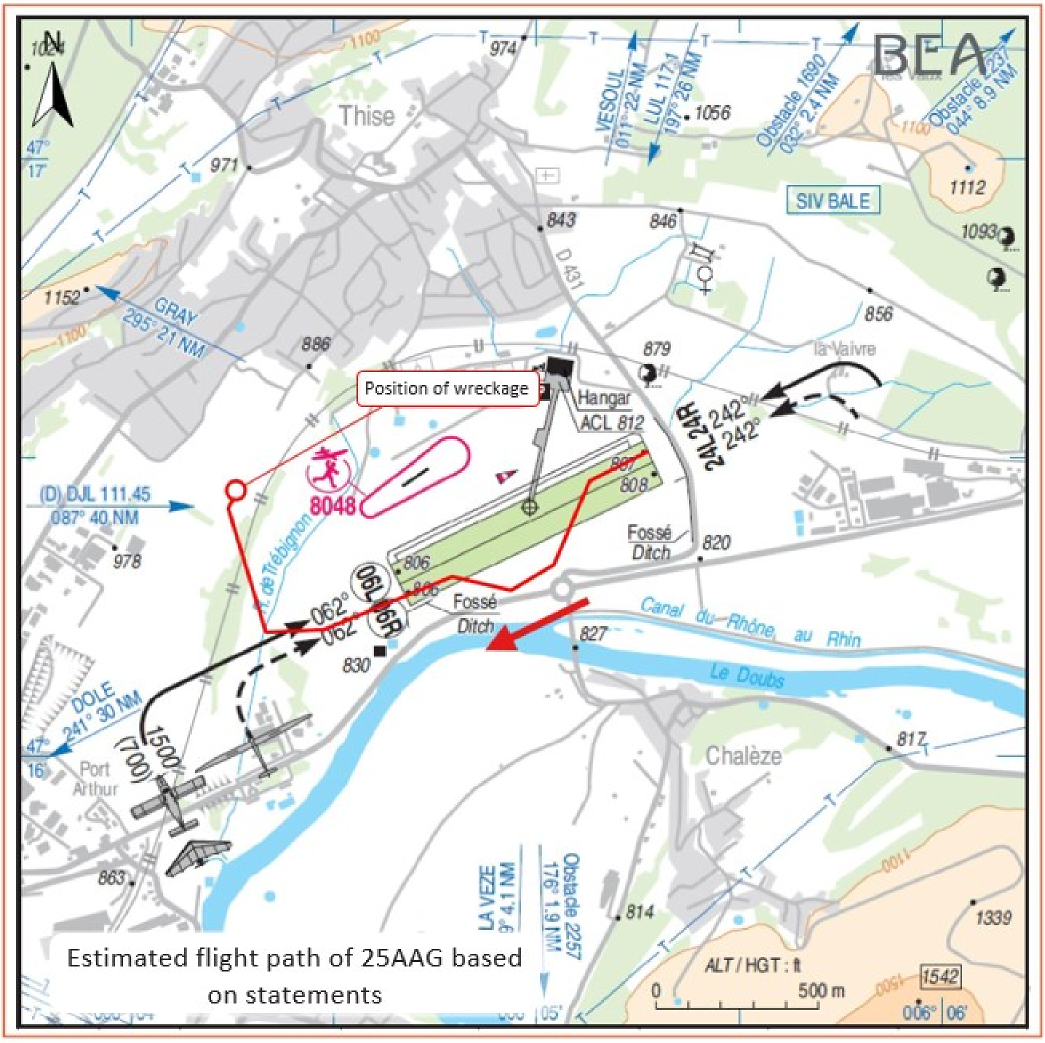

Figure 1: flight path described by the eyewitnesses and position of the wreckage of 25AAG (Source: SIA, annotations BEA)

2 ADDITIONAL INFORMATION

2.1 Aerodrome information

Besançon - Thise aerodrome has two unpaved parallel runways, 06L/24R and 06R/24L. The reference altitude is 246 m (807 ft). Runway 24R, used by the pilot, measures 875 m x 66 m. For both runways, the aerodrome circuit is carried out in the south.

2.2 Aéroservices Guépy 582 information

The microlight Aéroservices Guépy 582 is a two-seater, high fixed-wing aircraft equipped with a Rotax 582 two-stroke two-cylinder engine. The fuselage structure is composed of a fabric-covered tubular truss and the wing is composed of wood and fabric, reinforced with metal tubes.

2.3 Pilot information

The 60-year-old pilot held a microlight pilot certificate obtained in 2013. He had been the owner of 25AAG since 2011. According to the pilot's logbook, he had totalled 120 flight hours, including around 30 hours in dual flight carried out between 2009 and 2011 for his training. The pilot's last flight was back in February 2023. The pilot was a member of the microlight association "Les lépidoptères" based at Besançon - Thise aerodrome.

The pilot had not flown during the year preceding the accident flight due to maintenance work on the microlight (see paragraph 2.7). The pilot, who held a FFPLUM licence, had not asked to benefit from the Remise En Vol (refresher flight) programme for this first flight after a long break.

2.4 Statements

A member of the microlight association "Les lépidoptères" was present at the aerodrome before the flight. He stated that he saw the pilot take out a ten-litre jerrycan of fuel and combine his oil and petrol mixture. He also helped the pilot connect the elevator trim linkage, as the pilot believed the rigging was inverted. A little later, the pilot showed him that the stick interfered with the VHF radio he had installed on the instrument panel. As a result, the stick could not control full nose down deflection. According to the witness, it was also likely to interfere with roll deflection[3].

Several witnesses then saw the pilot carry out an engine ground-run on the parking. They thought that during these tests, the pilot did not run the engine up to full power and according to one of the witnesses, the power demand was less than half power. They did not notice any obvious malfunction at that time.

Several witnesses explained that, during the take-off, the microlight's flight path was unusual: they described a clear deviation to the left, before returning to the runway axis with variations in engine speed. They did not know whether these variations were controlled or uncontrolled. The pilot then turned right and crossed the runway axis. The witnesses heard further variations in engine speed. Several of these witnesses indicated that the microlight stalled[4] during the right turn, with a steep nose-up pitch attitude, overhead trees and facing the slope and the town of Thise.

According to the witnesses, the weather conditions were favourable for a VFR flight and the wind was calm. The pilot’s wife stated that he had programmed his flight for that day as it was the only day of good weather in that period.

2.5 Site and wreckage information

The wreckage was located in a field at an altitude of 274 m (900 ft), at 525 m from the end of runway 24R. This field had an upward slope. The bottom of the field was bordered by a row of trees of a height of approximately 15 m, running along a railway line.

No mark in the vegetation or on the ground was observed in the vicinity of the wreckage.

The microlight collided with the ground with a nose-down attitude close to 90°. All of the damage observed was the result of the collision with the ground.

[3] The microlight operating manual asks the pilot to check that the controls move freely and in the correct direction in its “Vital Actions” section before the “Take-off” section.
[4] The microlight was not equipped with a stall warning system.

Figure 2: wreckage of 25AAG (source: BEA)

The stick was broken and its deflection could not be checked[5]. The pitch, yaw and roll controls were continuous and the rigging was nominal. The elevator trim control, which is not one of the original microlight controls, was found in a close to neutral position. However, it was inverted with respect to the expected effects on the elevator.

The fuel tanks contained at least 15 litres of fuel, the quantity observed during the examination of the wreckage. Fuel had leaked through a disconnected hose on the accident site.

The examinations of the wing structure revealed that the fabric/wood bonding was weak on the lower surface of the two wings without it being possible to determine if these areas could have separated in flight.

2.6 Additional examinations

2.6.1 Examination of engine

The powerplant assembly was removed and examined by the BEA. Despite substantial external damage in connection with the accident, the engine rotated freely. The ignition system and the electric pump, tested during the examinations, were functional.

The engine pistons and cylinders showed no signs of seizure, but general wear. The rear piston had been replaced and its cylinder re-bored (see paragraph 2.7). The front piston was the original one. Both pistons were out of tolerance with respect to the diameters specified in the manufacturer's documentation, due to pronounced wear. According to the manufacturer, the large gap measured between the pistons and their associated cylinders could cause chronic power loss in the engine. This gap, just as the measured leak rate, was a lot greater at the front, creating unbalance between the two cylinders when the engine was operating.

2.6.2 Examination of front carburettor

The Rotax 582 engine was equipped with two carburettors, one per cylinder. A throttle slide, guided by a keyway and associated with a needle, allows the carburettor to regulate the flow of the air/fuel

[5] It was thus not possible to confirm the statement made by a member of “Les lépidoptères” (see paragraph 2.4).

mixture drawn into the cylinder according to the position of the throttle control. On the front carburettor of 25AAG, this throttle slide was blocked in the up position, i.e. in the 'full throttle' position, despite the load of the spring to keep it in the down position when the power was reduced.

Examinations carried out on the body of the front carburettor revealed an irregularity on its inner surface, approximately 100 microns thick, which may have caused this blockage. Observations made on the surface of this irregularity (scratches, polished appearance, buttering) indicate repeated sliding of the throttle slide in the carburettor body, clearly indicating the presence of the irregularity prior to the accident flight.

It was not possible to formally determine what caused this irregularity. The most likely hypothesis is a localised external impact which occurred during maintenance work, for example. Damage is indeed visible on the corresponding external surface. Tests carried out by the BEA on the second carburettor showed that this hypothesis was quite possible: an external impact caused local deformation on the inner surface. The hypothesis of a local manufacturing irregularity was ruled out due to the drilling process used on this moulded part.

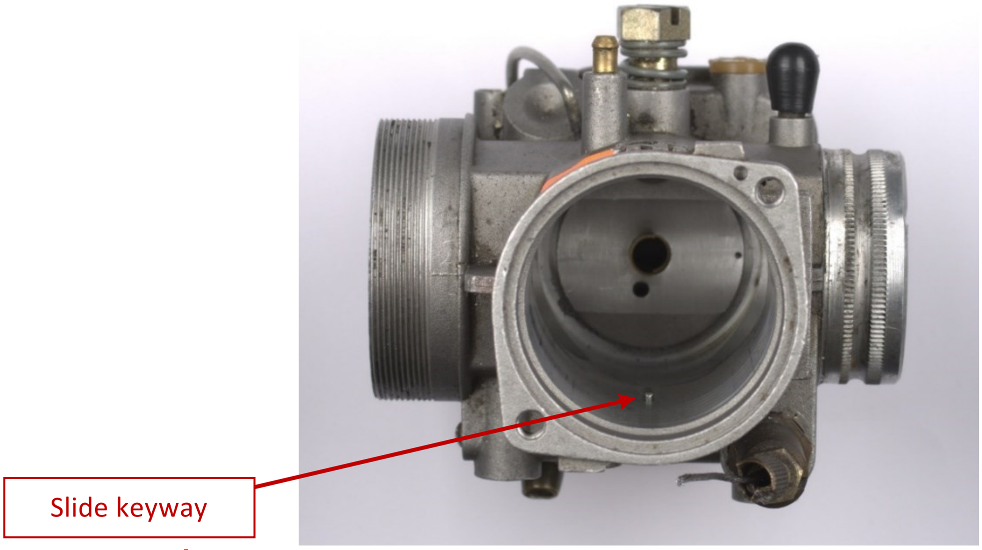

Figure 3: front carburettor, viewed from above (source: BEA)

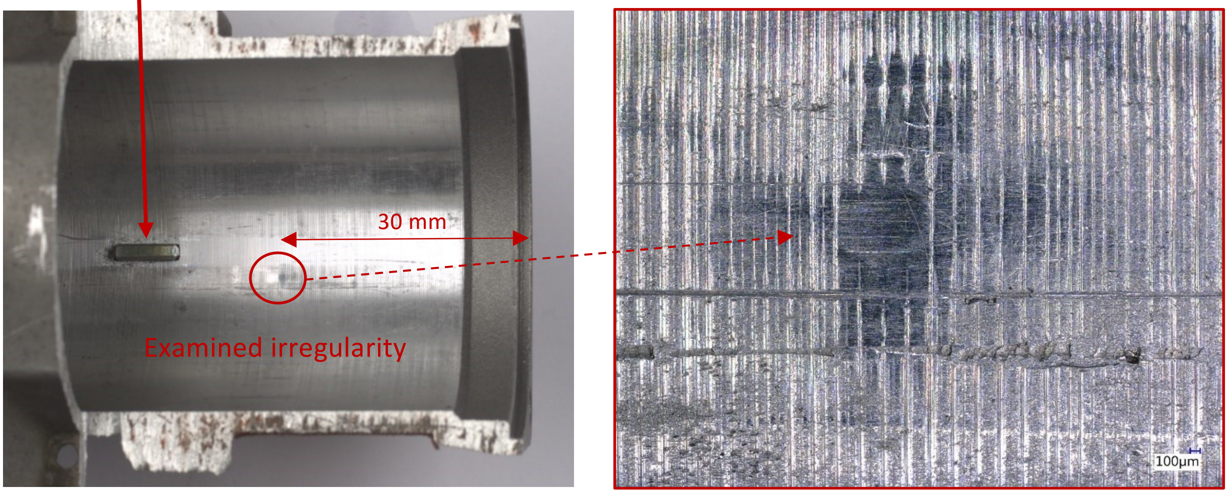

Figure 4: surface irregularity in body of front carburettor, observed after cutting open body on longitudinal axis (source: BEA)

A difference in position between the two throttle slides could cause a desynchronization of the two carburettors. This would result in an imbalance between the thrust developed by each piston, leading at the very least to strong vibrations and variations in speed, and possibly even a reduction in the power delivered by the engine.

2.6.3 Fuel analysis

The Rotax 582 engine is designed to run on a mixture of petrol and oil at a ratio of 2%. Fuel samples were taken and analysed by a laboratory selected by the BEA. The fuel had a chromatogram corresponding to that of SP98 unleaded motor fuel. No traces of any other type of fuel were found. The fuel samples showed traces of oil corresponding to the semi-synthetic product YACCO AVX 500 2T[6]. In each sample, the oil content could not be determined.

The investigation was not able to determine whether there was any old fuel still in the tanks prior to the refuelling described by the witness (see paragraph 2.4).

2.7 Maintenance information

The pilot carried out the maintenance and ensured the continuing airworthiness of the microlight himself, calling on friends for certain operations. He recorded all the work in a maintenance logbook. The pilot consulted neither the microlight manufacturer nor the French importer of the engine with respect to these various maintenance operations.

The pilot regularly carried out actions on the microlight's engine, particularly the carburettors. The words ‘carburettor cleaning’ appeared approximately every ten hours of operation. The microlight was rarely used and had flown around 100 hours over the last twelve years.

In 2018, with the help of a friend who is a pilot and mechanic specialising in bicycles, motorbikes and garden machinery, the pilot replaced the rear piston of the engine and re-bored the cylinder to the dimension of the first repair. The engine manufacturer stated that it is customary to replace both pistons and to re-bore both cylinders simultaneously to the first repair dimensions in the event of wear, as they are likely to wear in the same way. However, when seizure occurs in one of the cylinders, only that cylinder is repaired. Nevertheless, these two recommendations are not specifically mentioned in the engine documentation.

After the replacement, according to the maintenance logbook, the pilot broke in the engine on the apron, running it at 3,000 rpm, then 4,000 rpm and finally 6,000 rpm for periods of five minutes each. The tests carried out differed from the instructions in the manufacturer's documentation[7]. In its documentation, the manufacturer recommends breaking in the engine in accordance with the following graph when replacing a cylinder, piston or piston rings.

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[6] This engine oil reference is not listed by the manufacturer in the 2009 SI-2ST-008 "*SELECTION OF SUITABLE OPERATING FLUIDS FOR ROTAX® 2-STROKE UL ENGINES*" available free of charge in English at https://www.flyrotax.com.

[7] The Installation Manual in English is available free of charge in the *Technical Documentation* section of the site https://www.flyrotax.com.

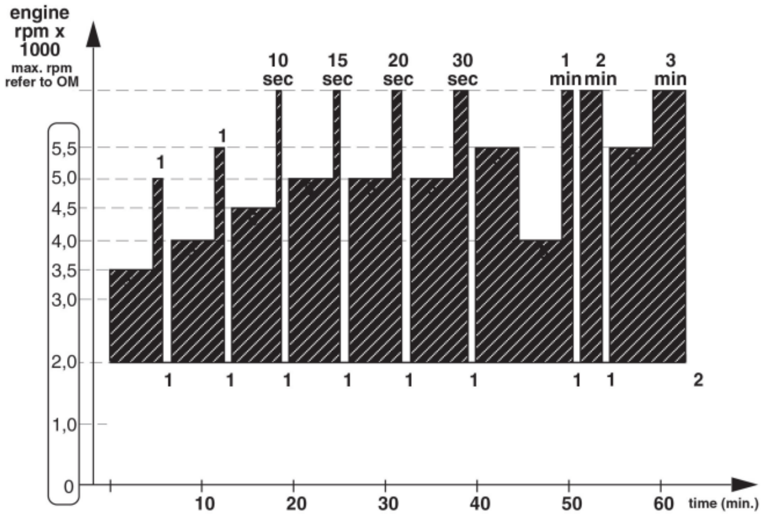

Figure 5: graph specifying the parameters for engine tests or breaking in (source: Rotax)

Between 21 February 2023 (last flight before the accident flight) and 28 May 2024 (day of the accident), the microlight underwent several operations, including the replacement of the wing skin and painting. According to the maintenance log, the pilot also cleaned the carburettors and fuel tanks, and replaced various hoses and the fuel filter. Several of the pilot's friends indicated that he had not taken any special measures to preserve the engine during this downtime. The manufacturer's documentation[8] recommends complying with an engine preservation procedure whenever a downtime of more than one week is planned. For a longer downtime of between four weeks and one year, a preservation oil must be injected into the cylinders, the carburettor air intakes must be closed and the fuel completely drained from the fuel system up to the carburettor tanks. A manufacturer's Information Bulletin[9] was published in 1998 on procedures for the preservation and returning to operation of the engine after a prolonged downtime. It specifies that if the engine is returned to operation after a downtime of more than one year, it must be inspected by an authorised Rotax centre.

A friend of the pilot, who is also a pilot, replaced the wing skin; he had already carried out this type of operation around thirty times. This friend had recommended to the pilot that he carry out engine tests with full power before the first flight and that he be accompanied by a more experienced pilot for the first flight after a period of not flying. The paint work was carried out by another friend of the pilot, a professional bodywork repairer, who had offered to provide professional help with this task. The microlight manufacturer does not provide specific instructions for this type of work.

[8] The Operators Manual in English is available free of charge in the *Technical Documentation* section of the site https://www.flyrotax.com.

[9] Rotax Service Information *"SI-11-1996_Engine preservation for 2-stroke-UL-engines"* in English is available free of charge on https://www.flyrotax.com.

3 CONCLUSIONS

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

Scenario

The pilot was carrying out his first flight after a long period of inactivity lasting more than a year, during which he had carried out various maintenance tasks on his microlight. Before the flight, on the parking, the pilot carried out an engine ground-run during which, according to witnesses, he ran the engine up to moderate power.

The bore of the front carburettor had a slight irregularity. When power was applied for take-off, the front carburettor throttle slide may have become blocked in the up position (full throttle position). When the pilot reduced power in climb, the difference in position between the throttle slides may have caused the two carburettors to desynchronize. The imbalance between the thrust developed by each of the two pistons may have led to strong vibrations, engine speed variations, and a decrease in engine power. Witnesses on the ground did indeed perceive significant engine speed variations during the flight.

The investigation was unable to explain the flight path followed by the pilot.

The pilot found himself overhead a row of trees and an upward sloping field, before the town of Thise. He lost control of the microlight as he began a turn at low height.

Contributing factors

The following factors may have contributed to the engine failure during take-off for the first flight after more than a year of not being used:

- the engine maintenance carried out by the pilot, which did not comply with the manufacturer's recommendations;
- incomplete engine tests, in particular the absence of full power tests. This type of test would probably have resulted in the front carburettor throttle slide blocking in the 'full throttle' position and would have allowed the fault to be detected on the ground. In any case, this test did not cover the carburettor bore with a film of oil over its entire stroke before take-off.

The pilot's small amount of recent experience and lack of retraining were not conducive to him maintaining control of the microlight, as he was probably faced with severely degraded engine performance at low height, which could have required an emergency landing.

Safety lessons

Partial or progressive degraded engine performance

A major failure, such as a total loss of engine power, leaves no choice but to make a forced landing. Pilots are generally trained and have practise in dealing with this type of anomaly during take-off. Regardless of whether engine performance was totally or partially degraded, a BEA study[10] has shown that in the event of a malfunction during take-off, the fatal accidents were all the result of a loss of control in flight, itself following a significant change in heading.

[10] Reduction in engine power during take-off published in March 2021.

When the engine malfunction is partial or gradual, the pilot may be strongly tempted to manoeuvre, for example by performing an appropriate circuit. If there is still some power, this may encourage the pilot to seek to avoid damaging the aircraft during a precautionary landing outside the aerodrome. In these circumstances, the use of resources to understand an anomaly that could be perceived as correctable may distract the pilot from monitoring vital parameters such as speed or bank angle. Maintaining the appropriate airspeed for the chosen bank angles will enable the pilot to maintain control during manoeuvres. Generally, there is little training in these cases. The FFPLUM recommends that pilots recall the various types of failure that can occur during the take-off and the various associated options during a before take-off briefing (see *Mémo Sécurité du pilote d'ULM*).

Aircraft maintenance
In the Safety Lessons General Aviation section of its website, the BEA identified the "aircraft maintenance" theme in its 2021, 2022 and 2023 reviews. Several reports published by the BEA mention in-flight technical failures that pilots were unable to manage and which led to fatal accidents.

Microlights are generally characterised by their simple design and straightforward maintenance, which is carried out by the owner. The owner may call on the manufacturer or a professional if the work to be done exceeds their knowledge. The deliberate simplicity should not encourage owners to deviate significantly from the manufacturers' recommendations (aircraft and engine manufacturers). With regard to the long-term storage of a microlight, for example, owners have several options for preserving the engine, in particular, following the manufacturer's recommendations or, failing that, running the engine regularly.

Refresher flight *(Remise En Vol)*
The aim of FFPLUM's refresher flight programme is to bring pilots and instructors together on a voluntary basis. Flying with an instructor allows pilots to deal with normal and unusual situations, helping them to better understand these situations and avoid losing the reflexes acquired during their initial training. A theoretical and practical programme is recommended, covering topics such as stalls and sharp turns. This initiative is particularly recommended after a long period of inactivity.

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